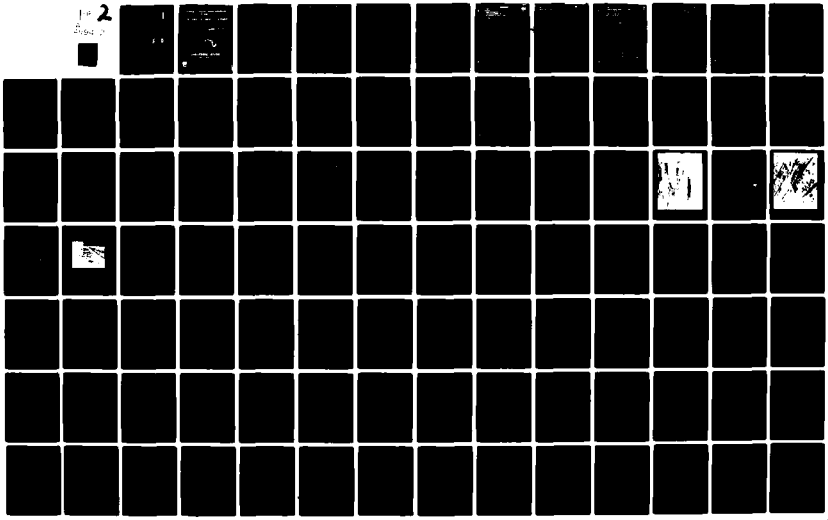
AD-A119 482 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
GENERAL DESIGN MEMORANDUM. PHASE I AND ENVIRONMENTAL IMPACT STA--ETC(U)
JAN 82

UNCLASSIFIED NL



PHOTOGRAPH THIS SHEET

DTIC ACCESSION NUMBER

LEVEL

INVENTORY

General Design Memorandum Phase I and Environmental Impact Statement for Flood Control and Related Purposes, Sheyenne River, North Dakota Jan. 82

DOCUMENT IDENTIFICATION

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	☒
DTIC	TAB	☐
UNANNOUNCED		☐
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A		

DISTRIBUTION STAMP

DTIC COPY INSPECTED 2

DTIC ELECTE SEP 21 1982 S D

D

DATE ACCESSIONED

"Original contains color plates: All DTIC reproductions will be in black and white"

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM OCT 79 70A

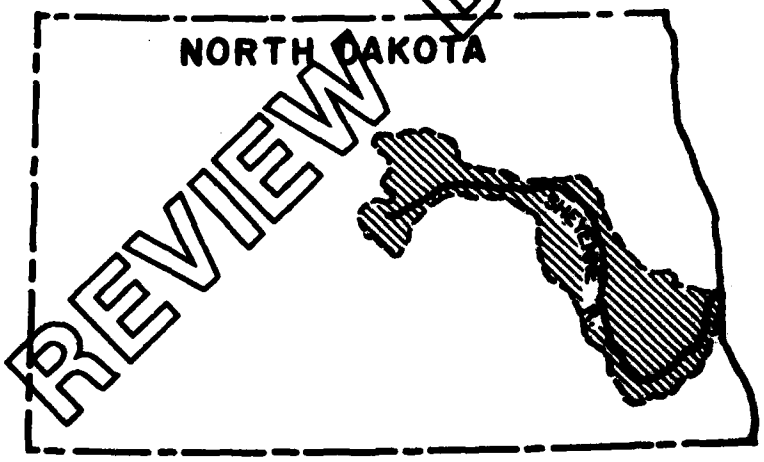
DOCUMENT PROCESSING SHEET

GENERAL DESIGN MEMORANDUM
PHASE I
AND
ENVIRONMENTAL IMPACT STATEMENT

FOR

FLOOD CONTROL AND RELATED PURPOSES

REVIEW DRAFT



AD A119482

SHEYENNE RIVER
NORTH DAKOTA

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

US Army Corps
of Engineers
St. Paul District

82 09 20 087 JANUARY 1982

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) GENERAL DESIGN MEMORANDUM PHASE I AND ENVIRONMENTAL IMPACT STATEMENT FOR FLOOD CONTROL AND RELATED PURPOSES, Sheyenne River, North Dakota		5. TYPE OF REPORT & PERIOD COVERED Review Draft 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Paul 1135 USPO & Custom House St. Paul, MN 55101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE January 1982 13. NUMBER OF PAGES 143 p.
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental impact statements
Flood control
Sheyenne River, North Dakota

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The selected plan would consist of a levee and diversion at West Fargo/Riverside; diversion from West Fargo to Horace; a 5-foot raise of Baldhill Dam. Fish rearing ponds and a hatchery building downstream of the dam would have to be replaced. About 140 acres of woodland and 125 acres of grassland would be required to compensate for the Dead Colt Creek tributary dam. Final mitigation requirements would be the responsibility of other agencies.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

GENERAL DESIGN MEMORANDUM PHASE I AND ENVIRONMENTAL IMPACT STATEMENT FOR FLOOD CONTROL AND RELATED PURPOSES, Sheyenne River, North Dakota.

5. TYPE OF REPORT & PERIOD COVERED

Review Draft

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

U.S. Army Engineer District, St. Paul
1135 USPO & Custom House
St. Paul, MN 55101

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

12. REPORT DATE

January 1982

13. NUMBER OF PAGES

143 p.

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Environmental impact statements
Flood control
Sheyenne River, North Dakota

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The selected plan would consist of a levee and diversion at West Fargo/Riverside; diversion from West Fargo to Horace; a 5-foot raise of Baldhill Dam. Fish rearing ponds and a hatchery building downstream of the dam would have to be replaced. About 140 acres of woodland and 125 acres of grassland would be required to compensate for the Dead Colt Creek tributary dam. Final mitigation requirements would be the responsibility of other agencies.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SUMMARY OF DOCUMENTS AND CONTENTS
PHASE I GENERAL DESIGN MEMORANDUM

SHEYENNE RIVER, NORTH DAKOTA

DOCUMENT

I PHASE I GENERAL DESIGN MEMORANDUM AND ENVIRONMENTAL IMPACT STATEMENT

TECHNICAL APPENDIXES

II VOLUME 1

APPENDIX A: COORDINATION AND PUBLIC PARTICIPATION

APPENDIX B: HYDROLOGY

APPENDIX C: HYDRAULIC ANALYSIS AND INTERIOR DRAINAGE DESIGN

III VOLUME 2

APPENDIX D: ENVIRONMENTAL RESOURCES

APPENDIX E: CULTURAL RESOURCES

APPENDIX F: SOCIAL AND INSTITUTIONAL ANALYSIS

APPENDIX G: ECONOMIC ANALYSIS - FLOOD DAMAGE AND BENEFITS

APPENDIX H: WATER QUALITY

APPENDIX I: RECREATION RESOURCE ANALYSIS

IV VOLUME 3

APPENDIX J: COST ESTIMATES

APPENDIX K: GEOTECHNICAL

APPENDIX L: FLOOD DAMAGE REDUCTION ALTERNATIVES

APPENDIX M: PLAN FORMULATION

APPENDIX N: FISH AND WILDLIFE COORDINATION ACT REPORT

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Water Quality
SCOPE OF THE STUDY
STUDY PARTICIPANTS AND COORDINATION
SEQUENCE OF STUDIES
PROBLEM IDENTIFICATION
INTRODUCTION
NATIONAL OBJECTIVES
PUBLIC CONCERNS
PROFILE OF RESOURCE BASE (EXISTING CONDITIONS)
Water Resources
Environmental Resources
Human Resources
Economic Resources
Recreation Resources
Cultural Resources
Institutional Resources
ANTICIPATED FUTURE RESOURCE BASE (WITHOUT [illegible])
Water Resources
Environmental Resources
Human Resources
Economic Resources
Recreational Resources
Cultural Resources
Institutional Resources

[illegible]
[illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Levees and Revetments Changed at Fort Angel [illegible]

Flood Diversion Channel from Geneva to Bear Creek

PLAN COMPONENTS FOR IMPLEMENTATION BY OTHERS - [illegible]

Floodplain Regulations

Control of Private Large Construction

Control of Drainage

PLAN COMPONENTS FOR IMPLEMENTATION BY OTHERS - [illegible] IN ACHIEVING OBJECTIVES

Flood Emergency Measures

Flood Warning and Forecasting

Flood Insurance

Multiple-Purpose Dam on Bear Cult Creek

Ring Levees at Permanent and Residences

Increasing the Floodwater Storage Capacity of [illegible] Drained Wetlands

Debris Removal

Flood Proofing

Encouragement of Public Control/[illegible]

Encouragement of More Land Treatment

Assessment And Monitoring of [illegible]

Flash Gauge Monitoring

Environmental Monitoring

Social Vulnerability Monitoring

Economic Monitoring

Continuing Work [illegible]

Executive [illegible]

Monitoring [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLES

NUMBER		PAGE
1	SUMMARY OF HISTORICAL FLOODS, SHEYENNE RIVER BASIN, NORTH DAKOTA	5
2	SUMMARY OF FIRST AND SECOND PEAKS OF 1979 FLOOD	11
3	SUMMARY OF LOW-FLOW DATA FOR SHEYENNE RIVER AND RED RIVER OF THE NORTH AT FARGO	14
4	LAND USE IN THE SHEYENNE RIVER BASIN	16
5	COMPARISON OF NUMBER OF FISH SPECIES FOUND IN DIFFERENT RIVERS IN NORTH DAKOTA	17
6	SUMMARY OF WHITE-TAILED DEER HARVEST INFORMATION	18
7	POPULATION OF CITIES AND COUNTIES, LOWER SHEYENNE RIVER BASIN	19
8	SUMMARY OF CHARACTERISTICS OF FLOOD-PRONE AREAS	21
9	MEASURES CONSIDERED FOR FLOOD DAMAGE REDUCTION, SHEYENNE RIVER BASIN, NORTH DAKOTA	46
10	ALTERNATIVE MEASURES CONSIDERED TO PRESERVE OR ENHANCE THE FISH AND WILDLIFE RESOURCES OF THE SHEYENNE RIVER BASIN	48
11	FLOOD DAMAGE REDUCTION PLANS FOR THE SHEYENNE RIVER, NORTH DAKOTA	53
12	SUMMARY OF RELATIVE MERITS OF FLOOD DAMAGE REDUCTION PLANS	54
13	SUMMARY OF COMMENTS RECEIVED ON STAGE 2 REPORT, PRELIMINARY PLANS	55
14	SUMMARY OF CONSIDERATIONS ON FLOOD DAMAGE REDUCTION MEASURES CONSIDERED IN STAGE 2	60
15	SUMMARY OF THE COMPONENTS IN THE FINAL MIXTURE OF PLANS	71
16	[illegible] OF PRELIMINARY PLANS ON FINAL MIXTURE OF PLANS	75
17	EFFECTIVENESS OF TENTATIVELY SELECTED PLAN IN REDUCING FLOOD DAMAGES	[illegible]

[redacted]

[redacted]

[redacted]

1 [redacted]

2 [redacted]

3 [redacted]

4 [redacted]

5 [redacted]

6 [redacted]

PLATES

1 AUTHORIZED RUSHFORD LAKE PROJECT LOCATION MAP

2 SELECT PLAN COMPONENTS LOCATION MAP

3 LEVEES AND FLOOD DIVERSION SYSTEM AROUND WEST FARGO/RIVERSIDE (M-29 TO M-24)

4 DIVERSION OF THE SHEYENNE RIVER (M-42 TO M-24)

5 PROPOSED RAISE OF BALDHILL DAM

PREFACE

The "Review Draft" Phase I General Design Memorandum and Environmental Impact Statement for flood control and related purposes in the Sheyenne River basin, North Dakota, presents the findings, conclusions, and recommendations of the Phase I studies conducted from February 1976 through December 1981. The information in the report is subject to revision.

The report addresses the water resource and related problems and needs of the lower Sheyenne River basin with particular emphasis on reducing flood damages - the most significant local water resource need. The goal of Phase I is to identify a plan for water resource development that meets the needs of the basin, is consistent with the national objectives of economic development and environmental quality, and is implementable.

The Phase I study completely reevaluates and reformulates work done during the feasibility study (1963 through 1968). The 1968 feasibility report recommended construction of the multiple-purpose Kindred Lake project. The Kindred Lake project would reduce flood damages, improve water quality, provide for recreation, and enhance fish and wildlife. The report also recommended that Baldhill Dam be operated to provide more flood control storage before spring runoff.

In 1970, Congress authorized the Kindred Lake project for construction. Before funds were appropriated for the Phase I studies, special studies examined the effects the project would have on groundwater levels in the Sheyenne National Grassland, the potential shoreline erosion around Kindred Lake, and the effects the project would have on water quality. In 1976, following completion of these studies, the Corps received appropriations to begin Phase I studies.

Several events occurred between completion of the feasibility study (1968) and the start of Phase I (1976) that significantly changed planning guidelines. These changes required a complete reevaluation of the study area. The events included:

1. Passage of the National Environmental Policy Act of 1969.
2. Completion of the special studies (1974).

3. Adoption by the Water Resources Council of new principles and standards for planning water and related land resources (1973).

4. Uncertainty in the status of the Garrison Diversion Unit (1975 and 1976).

The principal elements of the water resource plan selected on the basis of Phase I studies are:

- Adoption (or continuation) and enforcement of floodplain regulations in flood-prone areas of the basin (non-Federal implementation).
- Enforcement of drainage laws to ensure that future drainage of wetlands would not increase downstream flood damages (non-Federal implementation).
- Control of private levee construction to prevent increases in upstream and/or downstream flood damages (non-Federal implementation).
- Levees and a flood diversion channel at West Fargo/Riverside (Corps of Engineers implementation with a non-Federal sponsor).
- A flood diversion channel from Horace to West Fargo (Corps of Engineers implementation with a non-Federal sponsor).
- A 5-foot raise of Baldhill Dam to provide additional flood control storage (Corps of Engineers implementation with a non-Federal sponsor).
- Ring levees at individual flood-prone farmsteads and residences (non-Federal or other Federal agency implementation or continued evaluation for potential Corps of Engineers implementation).
- A multiple-purpose dam for flood control and recreation on Dead Colt Creek, a tributary of the Sheyenne River (non-Federal implementation).
- Increase in the capacity of wetlands (drained and existing) to store floodwaters (non-Federal or other Federal agency implementation).

The "Review Draft" consists of the main report and environmental impact statement and three volumes of technical appendixes.

The main report summarizes the water resource and related problems and needs of the basin, the alternatives evaluated, and the process used to develop and select a plan. The conclusions of the study and recommendations for Federal participation (Corps of Engineers) are also in the main report.

The environmental impact statement, bound with the main report, describes the environmental effects of implementation of the selected plan and discusses the relative merits of the other alternatives.

The technical appendixes present the detailed information used in investigating the problems and needs, assessing the impacts of the alternatives, and evaluating the alternatives and technical details of the selected plan.

Comments on the "Review Draft" should be sent to:

District Engineer
St. Paul District, Corps of Engineers
ATTN: NCSED-PB
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

INTRODUCTION

PURPOSE OF DOCUMENTATION

The purpose of this report and environmental impact statement is to provide for agency and public review of the information compiled during the Phase I General Design Memorandum (GDM) studies for flood control and other purposes on the Sheyenne River, North Dakota. The information in this report has been the basis for the formulation of water management plans to address basinwide water and related problems and needs. The Phase I GDM study is required by Corps of Engineers regulations to ensure that plans developed are consistent with basin needs and conditions and meet current evaluation criteria for Federal water projects. These studies comply with the U.S. Water Resources Council's Principles and Standards and with the appropriate Corps of Engineers regulations.

STUDY AUTHORITY/AUTHORIZED PROJECT

The Flood Control Act of 31 December 1970 (Public Law 91-611), Title II, Section 201, authorized the Secretary of the Army acting through the Chief of Engineers to construct and implement the Kindred Lake project and other improvements in the Sheyenne River basin. The authorized plan of improvement consists of a multiple-purpose reservoir for flood control, water quality control, recreation, and fish and wildlife on the Sheyenne River near Kindred, North Dakota, in combination with a revised operating plan at Baldhill Dam and appropriate floodplain management measures at Lisbon, Valley City, and West Fargo, North Dakota. The authorized Kindred Dam would be located at river mile 76 on the Sheyenne River, about 5 miles southwest of Kindred, as shown on plate 1.

This project is described in the report of the Chief of Engineers, dated 15 September 1969, House Document No. 91-330, 91st Congress, 2d Session. A summary of the authorized project is contained in Appendix M, Plan Formulation.

NEW INFORMATION SINCE THE SURVEY REPORT

The interim survey report, October 1968, recommended construction of the Kindred Lake project and other features. Since then, several events have occurred, additional information has been gathered, and further studies have been accomplished to assist in the evaluation of alternatives. Following are some of the principal items.

Hydrology

1. Floods - Major floods in 1969, 1975, 1978, and 1979 affected all or parts of the basin.

2. Drought - In the late summer, fall, and winter of 1976 and early 1977, very dry conditions were experienced in the basin.

3. Studies - Studies included delineation of drainage areas, development of HEC-1 and HEC-5C computer models to analyze runoff patterns and floods, reanalysis of frequency-discharge curves, and reanalysis of probable maximum discharges at the Baldhill and Kindred Dam sites. Additional information on the hydrology of the Sheyenne River basin can be found in Appendix B, Hydrology.

Hydraulics

Studies included the development of the HEC-2 computer model to analyze water surface profiles for floods, development of stage-discharge relationships on the lower Sheyenne River, and analysis of the effects of backwater from the Maple River and Red River of the North on the water surface profile from West Fargo downstream. Additional information on the hydraulic characteristics of the Sheyenne River can be found in Appendix C, Hydraulic Analysis and Interior Drainage Design.

Environmental

Studies included acquisition of false color infrared imagery along the Sheyenne River, development of base-line environmental data, inventory of cultural resources of the basin, analysis of groundwater levels and

vegetation types in the Sheyenne delta area, and mapping of habitat types in the Baldhill Dam and Kindred Dam areas. Additional information on Environmental Resources is contained in Appendix D, and on Cultural Resources in Appendix E.

Social

A social profile of the area's base-line condition and a social impact assessment of the alternatives were developed. An institutional analysis was developed to describe the interrelationship of agencies and organizations involved in water resource development in the Sheyenne River basin. Additional information on social and institutional characteristics is contained in Appendix F.

Public Involvement

A citizens committee representing interests in the lower Sheyenne River basin was formed to provide public input to the study. A discussion of the public involvement process conducted for the study is contained in Appendix A, Coordination and Public Participation.

Economic

Studies included a detailed inventory of floodplain properties including residences, businesses, industries, public facilities, and agricultural lands and an analysis of land use patterns and projected future trends in the flood-prone areas. Additional information on the flood damage characteristics of the basin is contained in Appendix G, Economic Analysis - Flood Damages and Benefits.

Water Quality

Studies included collection of water quality and sediment data at several locations on the Sheyenne River. Information on the water quality characteristics of the basin is contained in Appendix H.

SCOPE OF THE STUDY

The Phase I GDM study for the authorized Kindred Lake project is being conducted as a complete reevaluation of problems and needs and reformulation of alternatives to address those problems and needs. Because of the reevaluation nature of the study and the sensitivity of the issues involved, the name of the study has been changed from the Kindred Lake project to the Sheyenne River Flood Control project. The authorized project purposes were flood damage reduction, water quality control, recreation, and fish and wildlife. The reformulation studies are addressing all of these purposes plus water supply; however, the principal emphasis is on flood damage reduction. The principal study area is that portion of the Sheyenne River basin from the Baldhill Dam downstream to the confluence of the Sheyenne River and Red River of the North, with emphasis on the flood-prone areas along the Sheyenne River.

STUDY PARTICIPANTS AND COORDINATION

The St. Paul District, Corps of Engineers, managed, conducted, and coordinated the Phase I GDM studies. Input was provided by other Federal agencies, North Dakota State agencies, consultants under contract, the Lower Sheyenne River Citizens Committee, water management districts, communities, and other interested parties and organizations. Appendix A presents a detailed discussion on the study's coordination and public participation. The Lower Sheyenne River Citizens Committee meetings offered the principal forum for the expression of public opinions concerning the study and for the transmittal of information to the public. Other Federal and State agencies also presented information at the Citizens Committee meetings. Planning, coordination, management, and decision making were conducted in an open public forum.

STUDIES OF OTHERS

Studies and reports by other agencies and interests which relate to the problems, needs, and alternative water management plans evaluated during this Phase I GDM study are listed below.

- The Garrison Diversion Unit by the U.S. Bureau of Reclamation is covered in several reports. The report to the International Joint Commission in 1976 by the International Garrison Diversion Study Board and the 1979 Final Supplemental Environmental Statement are the most pertinent.

- Sheyenne National Grassland Land Management Plan, Environmental Impact Statement, Richland and Ransom Counties, North Dakota, U.S. Forest Service, Billings, Montana, February 1980.

- Overall Water Resources Management Plan, Southeast Cass County Water Management District, West Fargo, North Dakota, 1974.

- Lower Sheyenne River Basin, Water-Land-People, North Dakota State University, Fargo, North Dakota, 1974.

- Souris-Red-Rainy River Basins Comprehensive Study, Souris-Red-Rainy River Basins Commission, 1972.

- North Dakota Interim State Water Resources Development Plan, SWC Project No. 322, North Dakota State Water Commission, Bismarck, North Dakota, 1968.

- Conservation Needs Inventory, North Dakota, U.S. Soil Conservation Service, Bismarck, North Dakota, July 1970.

PROBLEM IDENTIFICATION

INTRODUCTION

The problem identification process was conducted by addressing public and agency concerns and through technical analysis of the water and related land resources of the basin. Past studies and reports of other agencies as well as public meetings, interagency meetings, correspondence, and congressional testimony were used in assessing the

problem and needs perceived by the agencies and public. Interests outside the study area who might be affected were also involved. Technical analyses were conducted by the Corps of Engineers and other agencies to determine the extent and severity of the water and related land resource problems and needs. The relationship of these problems and needs to the resource base was described in quantitative terms as much as possible.

NATIONAL OBJECTIVES

The national objectives which guided this study are expressed in the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources (1973):

> "The overall purpose of water and land resource planning is to promote the quality of life, by reflecting society's preferences for attainment of the objectives defined below:
>
> A. To enhance national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency.
>
> B. To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems."

PUBLIC CONCERNS

The concerns of the public were assessed through public meetings, citizens committee meetings, correspondence, testimony before congressional committees, and media accounts of community and citizen concerns. Several of the key concerns expressed before and during evaluation of alternatives include:

- Citizens of Fargo, North Dakota-Moorhead, Minnesota, were very concerned about water supply shortages in late 1976 and early 1977 when flow in the Red River of the North dropped to zero.

- Residents along the Sheyenne River from Kindred to the mouth suffered considerable economic loss, mental anguish, and physical inconvenience during the floods of 1975, 1978, and 1979, 3 of the last 7 years.

- Residents along the entire Sheyenne River were adversely affected by the 1979 flood and had a strong wish to see some type of flood damage reduction measures implemented.

- Public concern in North Dakota over the continued acquisition of wetlands was expressed through a stoppage of the Federal wetland easement program. Continued removal of property from the tax roles was one of the items of concern.

- Public concern was expressed over the continued loss of woodlands and wetlands and the degradation of aesthetic qualities and wildlife habitat in the basin. Preservation of these values is a general public concern.

- Dissatisfaction with the potential impacts of the multiple-purpose Kindred Dam was expressed, centering on the issues of the number of families to be relocated, the large number of acres to be taken from private ownership, potential changes in ranching operations in the adjacent lands as a result of the raised groundwater table, and impacts on the woodlands and wildlife habitat in the reservoir area.

- Residents in flood-prone areas consider the increased flooding of the past several years to be a direct result of drainage of wetlands and farmland. Much concern has been expressed for having the uncontrolled drainage stopped to prevent any further increase in flooding.

- Many opponents of the authorized Kindred Lake project expressed their concern that the Corps of Engineers objectively analyze the

alternatives to the authorized project. All affected parties in the lower Sheyenne River basin expressed the view that an objective reanalysis should be done.

PROFILE OF RESOURCE BASE (EXISTING CONDITIONS)

This profile of the basin's resources represents existing conditions. The completion dates of the data base collection and/or descriptions may vary; however, these descriptions are based on the best available information at the time of publication.

Water Resources

Surface Water. - The surface water resources in the basin have been observed and used by man since early settlement. Estimates and records of water flow first began around the late 1800's when newspaper accounts of flood levels were made. The U.S. Geological Survey started systematic and continuous observation of flow at West Fargo in 1929, Valley City in 1938, Cooperstown in 1945, Kindred in 1949, and Lisbon in 1956. Miscellaneous other observations were made before that time.

Early accounts of floods indicate that major floods occurred in 1882, 1883, and 1897 (see table 1). Newspaper accounts of the 1882 flood were found at Valley City and Fargo. Although no historical records of floods before 1882 have been found for the Sheyenne River, undoubtedly floods did occur but may not have been observed or recorded. Since the 1882 flood, at least 14 floods have occurred in the Sheyenne River basin. Table 1 summarizes the major floods in the basin.

Table 1 - Summary of historical floods, Sheyenne River basin, North Dakota

Year	Valley City		Lisbon		Kindred		West Fargo[1]	
	Maximum stage	Relative ranking[2]	Maximum stage	Relative ranking[2]	Maximum stage	Relative ranking[2]	Maximum stage	Relative ranking[2]
1882	20.0	1	(3)	-	(3)	-	(3)	-
1883	18.0	3	(3)	-	(3)	-	(3)	-
1897	15.0	6	(3)	-	(3)	-	(3)	-
1919	14.9	7	(3)	-	(3)	-	16.8	-
1947	10.2	-	(3)	-	22.1[4]	1	20.5	8
1948	17.5	5	(3)	-	(4)	1	18.5	10[8]
1950	14.6[5]	9	(3)	-	20.5	5	20.6	7
1952	6.0[5]	-	(3)	-	17.8	7	20.5	8
1965	14.9[5]	7	16.0	5	17.5	8	20.8	6
1966	14.3[5]	10	16.2	4	20.2	6	21.0	4
1969	17.6[5]	4	16.5	3	21.5	3	21.7	3
1975	10.3[5]	-	19.0	1	21.7	2	22.2	1
1978	8.9[5]	-	11.7	6	16.4	9	21.0	4
1979	18.9[5][7]	2	17.6	2	21.0	4	22.1	2
Flood stage[6]	13		11		16		16.5	

(1) Flood stage information at the U.S. Geological Survey gage on the north (downstream) side of West Fargo. This location is significantly affected by backwater from the Maple River and the Red River of the North and is not necessarily indicative of flood profiles through West Fargo.

(2) Relative rankings are based on the flood stages presented; only the top 10 are given a ranking.

(3) Data not available.

(4) In either 1947 or 1948, a stage of 22.1 was recorded. In the other year, a major stage was recorded although the exact magnitude is not available.

(5) Flood stages from 1950 to the present have been affected by the operation of Baldhill Dam. They are reduced from natural condition flood peaks. See Appendix B for further details.

(6) National Weather Service flood stage.

(7) Based on staff gage measurements by city at discontinued USGS gaging station.

(8) Floods occurred in 1962, 1953, and 1943 and had peak stages of 19.0, 18.8, and 19.4, respectively.

Each flood had different characteristics with respect to its occurrence and its relative magnitude at each city along the Sheyenne River. However, the floods have several common characteristics which are important to the analysis of flooding in the basin:

a. All the floods listed in table 1 occurred in the spring except for the July 1975 flood. Snowmelt combined with rainfall during runoff was the principal cause of these floods. The July 1975 flood resulted from an intense rainstorm which remained centered over the lower basin for 3 days, dropping over 15 inches of rain in many areas.

b. The long, narrow shape of the Sheyenne River basin results in the runoff from the upper basin arriving much later than the runoff from the lower basin. For most floods, there are two distinct and separate peaks in the lower basin from Lisbon to West Fargo. The relative magnitudes of the two peaks vary depending on the flood and the location. For example, at Kindred in 1969, the flow was greater during the first peak, which combined with ice to produce a higher stage than during the second peak even though the volume of the second peak was about twice that of the first peak. In 1966, the stage of the first peak at Kindred was greater than the second peak, largely because of ice; however, both the flow and the volume of the second peak were considerably greater than those of the first peak. Table 2 summarizes information on the first and second peaks for the April-May 1979 flood, where the stages at Kindred for the two peaks were comparable, but the flow and volume of the second peak were greater than for the first. In general, the first peak at Kindred comes from the runoff from the drainage area between Kindred and Baldhill Dam, approximately 1,100 square miles; and the second peak comes from the drainage area upstream of Baldhill Dam, approximately 3,812 square miles.

Table 2 - Summary of first and second peaks of 1979 flood

Item	Valley City		Lisbon		Kindred		Horace		West Fargo	
	First peak	Second peak	First peak	Second peak	First peak	Second peak	First peak	Second peak	First peak	Second peak
Date	18 Apr	25 Apr	20 Apr	2 May	19 Apr	7 May	21 Apr	8 May	21 Apr	2 May
Stage	10.95	18.86	12.65	17.58	20.72	20.75	15.7	15.85	22.12	21.22
Peak discharge (in cfs)	1785 (4)	4,900(2)	2620	4880	4,000	4,160	(3)	(3)	3,480	3,340
Duration of flow above flood stage (in days)	-	18 (2)	4	18	8	17	10	20	11	20
Total duration of flow above flood stage (in days)	(18)(2)		(22)		(25)		(30)		(31)	

(1) At the West Fargo U.S. Geological Survey gaging station, several peaks were experienced, both peak stages and peak flows: first peak stage and flow on 21 April; second peak stage on 30 April; third peak flow on 2 May; and fourth peak flow on 8 May.

(2) Based on estimates using stage measurements made during floods by NWS & Corps. Station discontinued in 1975 by USGS.

(3) The flows at Horace on the first and second peaks were estimated to be approximately equal but, because of the lack of specific measurements, are only estimated to be in the range of from 3,300 to 3,500 cubic feet per second.

(4) Estimate based on rating curve and model studies.

c. From Kindred to Horace, major breakout flows cause flooding. These breakouts tend to stabilize the flows remaining in the Sheyenne River from Horace through West Fargo. Thus, for peak flows over 4,000 cfs (cubic feet per second) registered at Kindred, flows of only about 3,000 cfs are registered at West Fargo. Many private levees paralleling the river have been constructed in the reach from Kindred to Horace, North Dakota, in the past decade. These levees tend to prevent breakout flows and, subsequently, maintain higher flows in the river through West Fargo.

d. Flood stages from the mouth of the Sheyenne River upstream through West Fargo are affected by backwater from the Red River of the North and the Maple River. Thus, flood stages in this reach are usually greatest during the combined peaks of the Red River of the North, the Maple River, and the Sheyenne River. The first peak of the Sheyenne River at Kindred usually coincides with the Maple and Red River peaks. Flood profiles through West Fargo vary from the first and second peaks as a result of this influence. Similar flood stages can occur at the south side of West Fargo during the second peak even though lower levels may be recorded at the U.S. Geological Survey station on the north side of West Fargo. The later arrival of the flows of the second peak does not contribute to peak flood stages along the Red River of the North and would normally affect only the duration of flooding at lower stages.

Additional data and discussion of the flooding and flood characteristics of the basin can be found in Appendix B, Hydrology. The backwater effects of the Maple River and Red River of the North on river stages along the Sheyenne River are discussed in additional detail in Appendix C, Hydraulic Analysis and Interior Drainage Design.

The low-flow periods on the Sheyenne River typically occur from June through March, with the lowest flows generally coming from September through February. The drought of the 1930's was the severest extended drought in the region. During the 4-year period from 1937 through 1940, a total of 48,000 acre-feet of runoff was produced upstream of Valley City, an average daily flow for the 4 years of just 15 cfs. During this period,

the flow was at or near zero in 25 months, with 9 of these months being consecutive. The low-flow periods at West Fargo, although not as severe as at Valley City, were also very low. The average daily flow for the lowest runoff year was 37 cfs in 1934. Average daily flows for 1938 and 1940 were 39 cfs, and in 1977 the average was only 45 cfs. If the flow in 1977 had not been supplemented by stored water from Lake Ashtabula, the low-flows would have approached the record low, since an average flow of only 13 cfs was recorded at Cooperstown, North Dakota. Table 3 summarizes some of the pertinent low-flow data for the Sheyenne River and the Red River of the North at Fargo.

Table 3 - Summary of low-flow data for Sheyenne River and Red River of the North at Fargo [1]

Item	Cooperstown	Valley City	Lisbon	Kindred	West Fargo	Red River of the North at Fargo
Period of record	1945-1979	1938-1979 [2]	1956-1979	1949-1979	1929-1979	1901-1979
Years of record	35	37	23	30	50	79
Lowest total annual runoff during period of record						
Year	1977	1977 [3]	1977	1959	1934	1934
Volume (acre-feet)	9,300	9,300 [3]	21,500	35,000	26,500	12,900
Average flow (cfs) for year	13	13 [3]	30	49	37	18
Number of months of zero flow in period of record	2	12	-	-	-	14
Number of months with flows less than 5 cfs	53	43	-	-	1	34
Average flow over entire period of record (cfs)	105	120	160	200	170	560

(1) Data in this display are presented only through 1979, although data are available to date at all locations except Valley City.

(2) Since 1975, the records which are gathered below Baldhill Dam can be considered as generally representative of the Valley City flows.

(3) Represents flow as measured below Baldhill Dam.

Sheyenne River flows are supplemented at various points along the river by groundwater entering from flowing springs and aquifer leakage. Perhaps the most notable area for flowing springs is in the Sheyenne Delta area near Kindred. This supplemental flow is perhaps the principal reason that the flow in the Sheyenne River at West Fargo never reached zero during the 1930's drought.

The most recent period of low flow was from late summer 1976 through spring 1978 when the flow in the Red River of the North was zero and water had to be released from Lake Ashtabula to meet water needs at Fargo.

Groundwater. - Most of the groundwater in the basin is found in glacial drift aquifers. About 24 percent of the basin is underlain by known or possible major aquifers. Groundwater, although fairly widespread, is not always available in quantities sufficient for use. The level of the aquifer being used by West Fargo as a source of water supply has been continually dropping as withdrawals exceed the recharge rates. Although levels appear to have stabilized in the last few years, continued withdrawals and declining water levels may require a shift to a surface water source in the future. The Sheyenne Delta aquifer is perhaps the most extensive and well known of the aquifers. It covers about 750 square miles and has thicknesses of over 100 feet. The water level throughout much of the aquifer is at or near the ground surface. Thus, a tremendous amount of water is stored in the aquifer. However, water is yielded from the aquifer at low rates because of the low transmissibility of the deposits.

Water Quality. - The water quality of the Sheyenne River is relatively poor and is directly related to land use. The river has high levels of ammonia and bacteria. High ammonia can result in fish kills, and bacteria can cause health problems. Lake Ashtabula is eutrophic, with high nutrient levels and frequent algal blooms. This condition reduces the fishery, recreational, and aesthetic qualities of the reservoir.

Environmental Resources

The Sheyenne River basin has three distinct physiographic areas: the Red River Valley, the Sheyenne delta sandhills, and the drift prairie. Most of the drift prairie lies upstream of Lisbon. The Red River Valley is downstream of Kindred, and the sandhills lie in between.

Of the more than 3 million acres in the basin, over 70 percent is devoted to cropland and only 1 percent, or about 38,000 acres, is woodland. The woodland is a very important resource from the standpoint of wildlife and vegetative composition. The woodland is essential to maintain healthy wildlife populations. The woodlands in the lower basin also provide habitat for a number of rare species of birds found nowhere else in North Dakota. The land use for the basin is illustrated in table 4.

Table 4 - Land use in the Sheyenne River basin

Land use	Acres	Percent
Cropland	2,400,000	71
Pasture or rangeland	650,000	19
Wetland	150,000	5
Urban	92,000	3
Large water	40,000	1
Woodland	38,000	1

Source: Land Use Assessment Needs, Non-Point Source Task Force, North Dakota Soil Conservation Service, Bismarck, North Dakota.

The vegetation of the basin is very diverse and contains many plants that are uncommon in North Dakota. The lower basin downstream of Kathryn, North Dakota, because of its expanses of woodland, geographic location, and microclimatic characteristics, is able to support species of plants that otherwise occur only in western North Dakota or farther east in Minnesota but virtually nowhere else in North Dakota. Eastern deciduous woodland species and western prairie species meet in the lower basin.

Similarly, many more species of fish are present here than in other areas of North Dakota, as shown in table 5. Fifty-three species of fish are found in the Sheyenne River; 49 downstream of Lake Ashtabula. The large diversity of fish in the river is due to the variety of habitats and substrates available.

Table 5 - Comparison of number of fish species found in different rivers in North Dakota

River	Number of fish species
Sheyenne	53
Downstream of Lake Ashtabula	49
Pembina	27
Forest	26
Wild Rice	12
Souris	45
Lake Sakakawea	48

Spring-fed streams in the lower basin, including the Mirror Pools, provide habitat for some uncommon fish species. These springs also provide refuge for species that require clear water.

Because of the diverse and relatively abundant vegetation, the basin contains many species of wildlife. From a recreation standpoint, the waterfowl, fish, upland game birds, and upland game wildlife are the most important. The rare species include white pelican, osprey, and redheaded woodpecker.

The most valuable wildlife habitat is provided by the existing wetlands, woodlands, and grasslands because of their relative scarcity or regional and national importance. The relatively large block of woodland in the Anselm, North Dakota, area is very important wildlife habitat. The wooded corridor along the river provides a route for wildlife movement between larger stands of woodland. The white-tailed deer is a major game species in the basin and throughout North Dakota. The sighting of deer, as well as other wildlife, is also highly valued by recreationists.

White-tailed deer are common from Devils Lake to Horace. The wooded valley bottoms are essential to their winter survival. The highest quality deer habitat is in the area between Kindred and Fort Ransom, North Dakota. Table 6 is a summary of data on white-tailed deer harvests.

Table 6 - Summary of white-tailed deer harvest information (1952-1971)

Area	Number of hunters	Hunters per 1,000 miles	White-tailed deer harvest: Total number	White-tailed deer harvest: Number/1,000 miles
State	39,903	576	21,008	323
Sheyenne River headwaters	2,374	457	1,446	285
Devils Lake	513	544	309	336
McVille	1,110	815	703	521
Lake Ashtabula	887	452	582	303
Kathryn	384	429	242	274
Lisbon	1,243	651	703	391

Source: Summarized from North Dakota State Game and Fish Department, Pittman-Robertson Reports, Bismarck, North Dakota.

The prairie chicken is a very rare species in North Dakota. Its preferred habitat, at least for booming grounds, is grassland. This bird is essentially restricted to the sandhills-grassland area where it is associated with sharp-tailed grouse. About 95 percent of the State's prairie chickens are in the Sheyenne National Grasslands.

On the basis of human use and the populations of plants and animals within its boundaries, the basin is one of the major wildlife, scientific, and recreational areas in North Dakota. The basin contains such unique areas as the wooded draws in Barnes County, wetlands for waterfowl, the Little Yellowstone area near Kathryn, the woodlands of the lower basin, the Mirror Pools area near Anselm, the sandhills, and grasslands. Together, these form a major North Dakota habitat and one of the few forests in the grassland and agricultural biome. Appendix D, Environmental Resources, contains additional detail and discussion on the existing environmental resource setting.

Human Resources

The human resources of the basin can be described by data on such items as population, education, and employment. These data cannot fully portray the people of the basin, but they offer a background from which to start.

Population. - The population centers of the lower Sheyenne River basin are the communities of Valley City and Lisbon and the West Fargo area.

The areas outside these cities are rural, with scattered farmsteads and intermittent small communities, except in the West Fargo area where there are many small developments whose residents work in West Fargo or Fargo.

Table 7 lists 1980 and projected 2030 populations for the counties and cities, parts or all of which constitute the lower Sheyenne River basin. Additional detail on the population trends for the area are presented in Appendix F, Socioeconomic and Institutional Analysis.

Table 7 - Population of cities and counties, lower Sheyenne River basin

City	1980 (1)	2030 (2)	County	1980 (1)	2030 (2)
West Fargo	10,080	23,500	Cass	88,243	137,500
Riverside	465	600	Barnes	13,949	11,800
Horace	497	1,100	Ransom	6,714	5,800
Harwood	326	570	Richland	19,197	19,800
Lisbon	2,286	2,600			
Valley City	7,771	9,400			

(1) Based on preliminary 1980 U.S. Census data.
(2) Summarized from projections developed in Appendix F.

Major population increases are expected in the Fargo-Moorhead metropolitan area of Cass County which includes the West Fargo, Riverside, Horace, and Harwood, North Dakota, areas. The populations of the rural areas outside the influence of the metropolitan area are expected to decrease gradually.

Education. - The area is well served by educational facilities, with several universities and colleges located in the FArgo-Moorhead metropolitan area. The formal educational level in the area varies, with the rural areas having lower attainment levels and the cities and metropolitan area having higher attainment levels. About 29 percent of the population in Cass, Barnes, Ransom, and Richland Counties have college degrees or some college education; the State average is about 20 percent.

Employment. - Although agriculture is the predominant industry in the basin, overall employment in the four-county area is dominated by nonagricultural jobs such as wholesale-retail trade, services, and government. The Fargo-Moorhead metropolitan area accounts for the bulk of the nonagricultural employment. Agriculture has offered less and less employment as mechanization and farm sizes have increased.

Economic Resources

The economy of the area is dependent on agriculture. When crop prices are high and yields are good, a healthy regional economy results. Per capita income figures used as a measure of income available for consumption at any one time show that the Fargo-Moorhead area is below the national and State averages for per capita income. This difference can be expected in an area heavily dependent on agriculture.

The potential for flood damages in the basin is summarized in table 8. The estimated number of residences located in the floodplain is over 3,500 and is based on physical counts at 1977 development levels. Population figures show that about 15,700 live in flood-prone areas and this estimate is based either on 1977 estimated populations for the communities or, in the rural areas, on three persons per residence. The floodplain area used for estimating acreages and residences is that area flooded by the 1-percent chance flood, which represents about 45,000 acres. The equivalent average annual flood damages for the Sheyenne River basin are estimated at $28,939,200, of which about 68 percent are located in the cities of West Fargo and Riverside.

Table 8 - Summary of characteristics of flood-prone areas

Category	Location	Acres subject to flooding	Damage per acre	Number of residences in floodplain (1)	Estimated population in floodplain (1)	Estimated average annual flood damages (2)
Urban	Valley City	-	-	625	1,900	$1,943,600
	Lisbon	-	-	161	480	376,700
	Harwood (3)	-	-	128	400	809,000
	Horace	-	-	123	340	492,600
	West Fargo	-	-	1,636	10,000 (4)	19,811,800
	Argusville	-	-	42	180	257,900
	Nonurban reach 5-A	-	-	172	520	1,054,500
	Nonurban reach 5-B	-	-	208	620	1,032,200
	Nonurban reach 5-D	-	-	316	950	1,371,400
	Nonurban reach 5-E	-	-	113	340	450,000
	Subtotal	-	-	3,524	15,730	27,599,700
Agricultural	Reaches 2-4 (Valley City to Kindred)	30,000	$9 to $21	NA	NA	88,400
	Reach 5 (Kindred to mouth)	65,000	$52	-	-	1,055,000
	Subtotal	95,000	-	-	-	1,143,400
Transportation		-	-	-	-	196,100
Total Sheyenne River				3,524 (5)	15,730	28,939,200

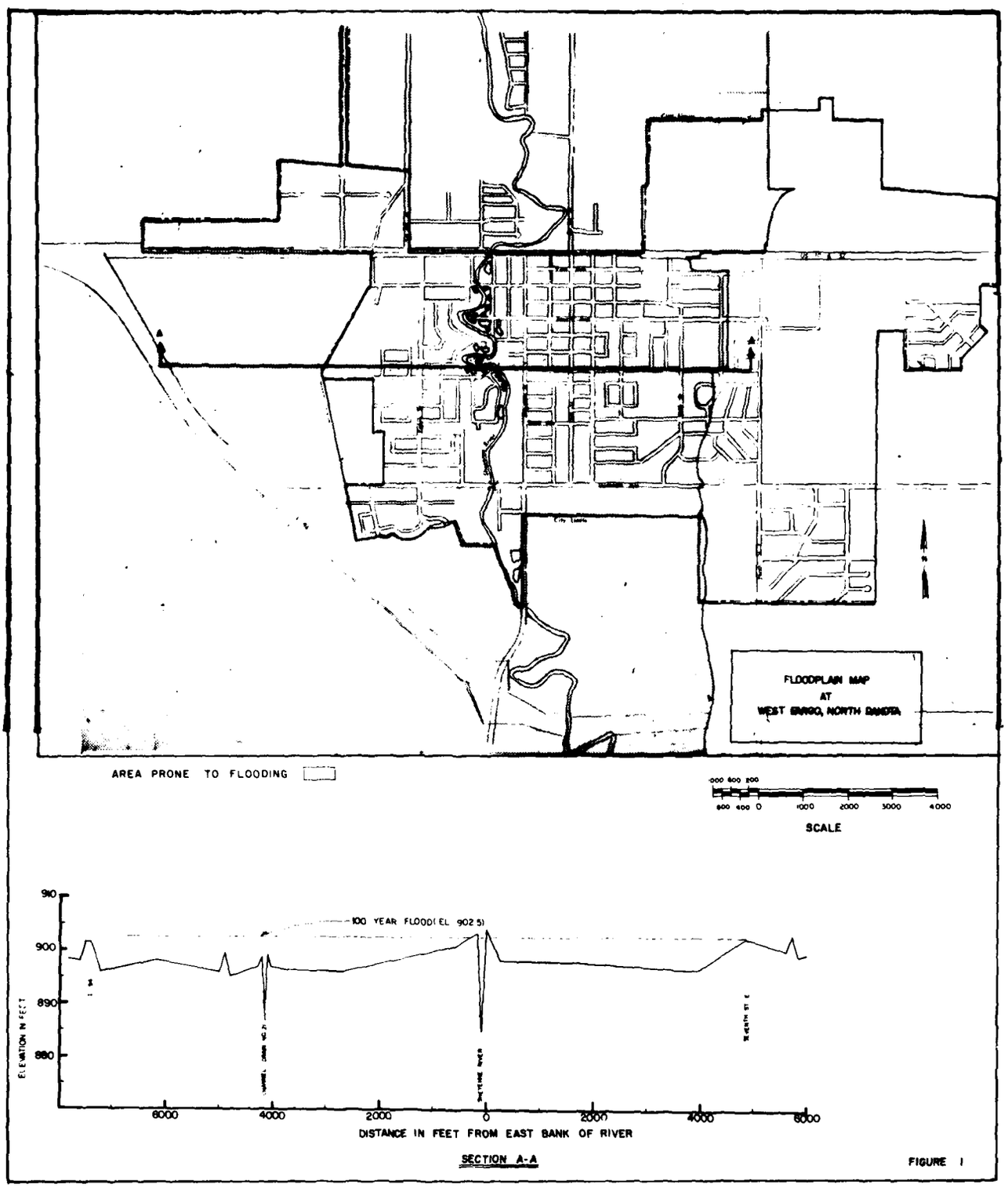
(1) Based on 1977 conditions.
(2) Over the 100-year period 1990 to 2090.
(3) Includes Brooktree and Rivertree.
(4) 1980 population figure.
(5) Number of residences may be greater because those located in rural reaches from Valley City to Kindred are not included.

The flood-prone area of West Fargo is shown on figure 1. An aerial view of the western part of West Fargo during the 1979 flood is shown on figure 2. Figures 3 and 4 present the flood-prone area map and an areal view of the 1979 flood, respectively, for Valley City. The flood-prone area map for Lisbon is presented in figure 5, and a typical view of ice flows during spring breakup floods on the lower Sheyenne River is shown on figure 6. In West Fargo, unlike Valley City and Lisbon, the riverbanks are among the highest areas in the city so that when the floods break out of the river channel the potential for damages is very high.

The city of West Fargo has been growing very rapidly, about doubling in population between 1970 and 1980 (about 5,265 in 1970 to 10,080 in 1980). Continued growth in West Fargo, Riverside, and scattered developments in surrounding rural areas is expected. Future developments should comply with floodplain regulations and will not result in increased flood damages for floods of magnitudes less than the 1-percent chance flood.

Recreation Resources

The Sheyenne River valley is a unique, scenic resource in eastern North Dakota. It is one of the few river valleys remaining largely in a natural state. The extensive wooded character (5 percent of the State's woodland acres) and high valley walls create an area of scenic and recreational value in contrast to the surrounding flat farmland. Major recreational opportunities within the valley include hunting, trapping, fishing, canoeing, camping, and hiking. Also, the U.S. Heritage Conservation and Recreation Service identified the 200 river miles from Horace to Valley City as worthy of some form of protection for its scenic and recreational values when considered as a potential candidate for the National Wild and Scenic Rivers System. However, it was not recommended for inclusion in the National Rivers System. A 110-mile section of the Sheyenne River is identified by the North Dakota State Outdoor Recreation Agency as a scenic canoeing river. A section of the valley between Anselm and Kindred is considered to be one of the best deer hunting areas in eastern North Dakota by Federal and State fish and game resource experts. Major constraints on the use of existing resources include such factors as poor public access, general



SECTION A-A

FIGURE 1

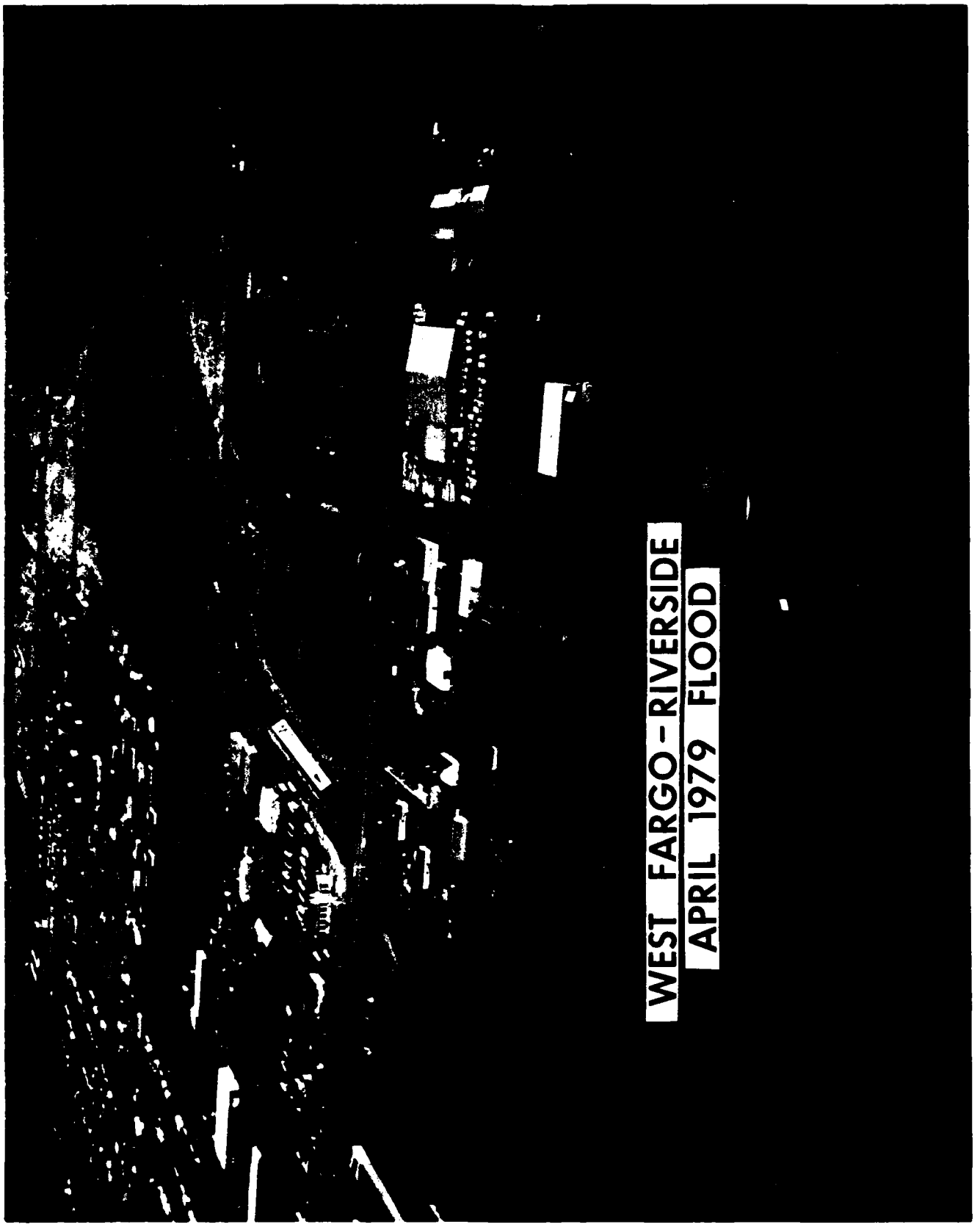
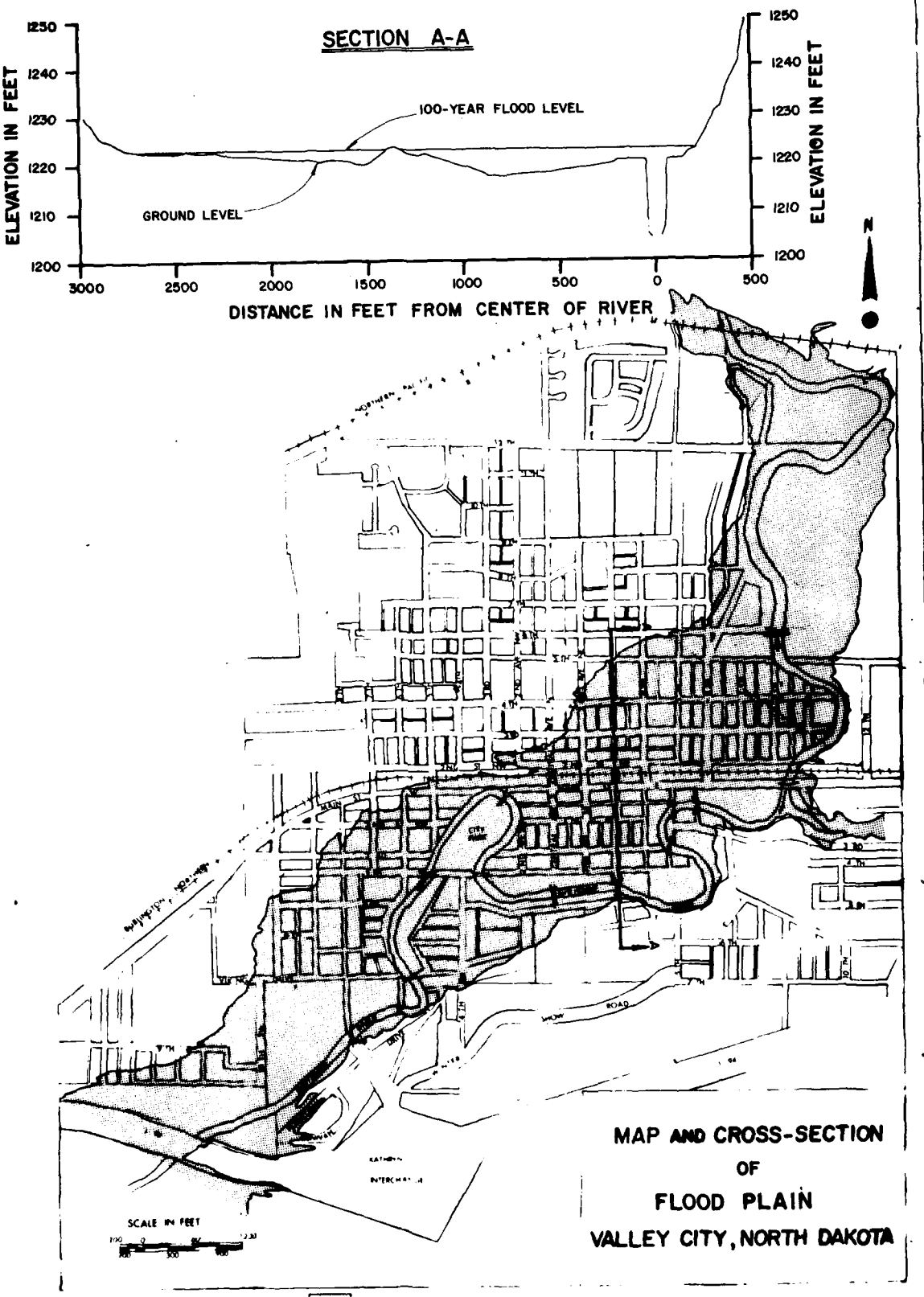


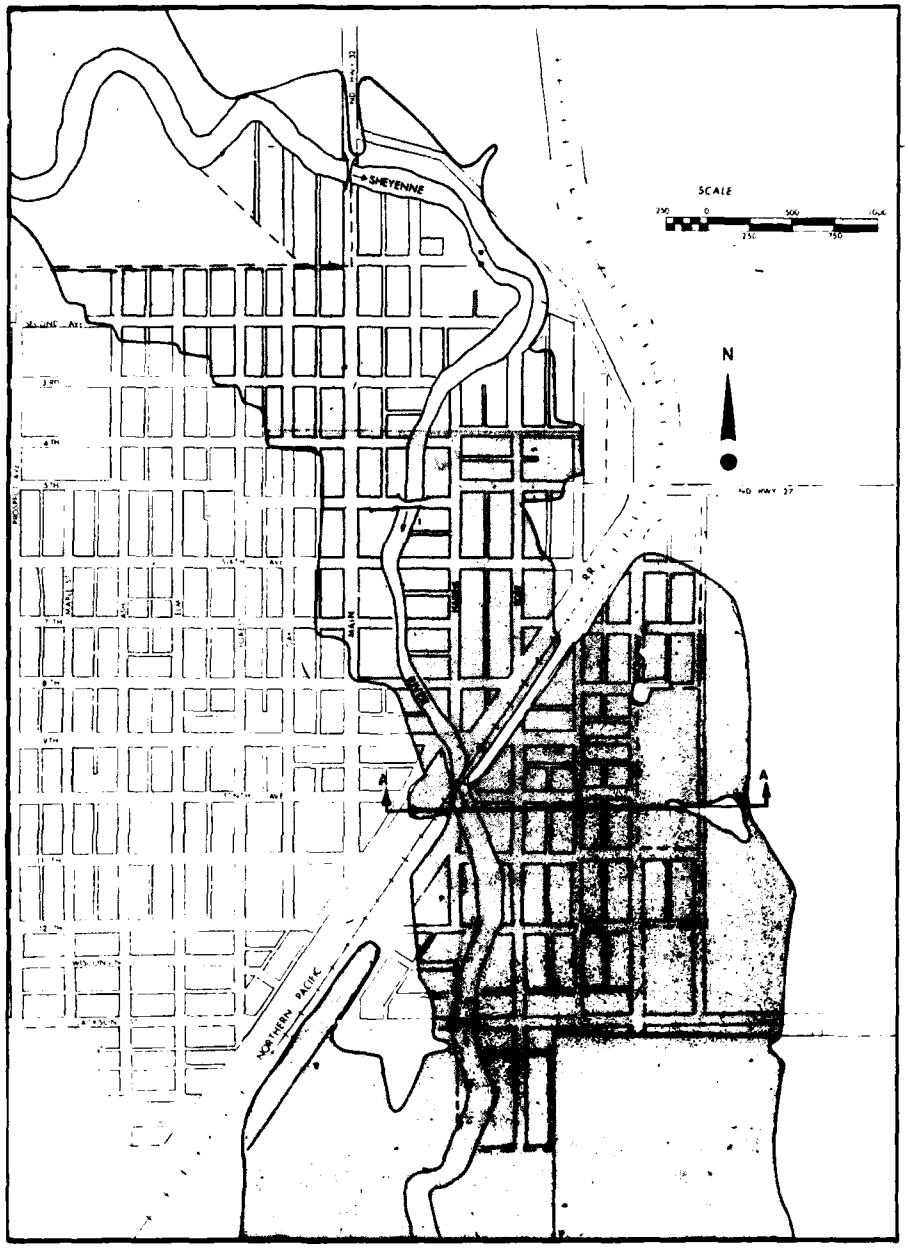
Figure 2



AREA PRONE TO FLOODING

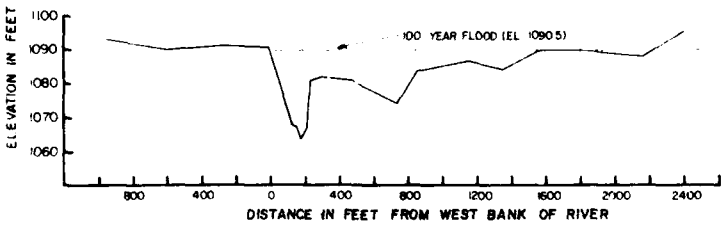
FIGURE 3

Figure 4



AREA PRONE TO FLOODING

FLOODPLAIN MAP
AT
LISBON, NORTH DAKOTA



SECTION A-A

FIGURE 6

Ice flow accumulations at bridge over Sheyenne River near Horace, North Dakota (20 April 1979)

Figure 6

lack of facilities, limited rural financial resources, inadequate maintenance of existing facilities, poor water quality, and lack of coordinated regional planning between government agencies.

The valley corridor provides an environment in which diversified recreation opportunities could be established. Existing and potential recreation resources provide an excellent opportunity for development of a recreation/environmental corridor composed of nodes of activity linked by various trail systems (incorporating the North Country Trail). Nodes of activity might include resources provided within urban areas (riverside parks, campgrounds); Federal, State, and county areas (Sheyenne National Grasslands, Fort Ransom State Park, Little Yellowstone, etc.); potential recreation facilities constructed as part of flood control improvements; and smaller activity centers such as fishing access points and hunting camps. Also, cultural sites as yet undefined could further enhance the interpretive and historic character of the valley and provide additional nodes of activity. The unique vegetative types; large number of bird species; and the scenic woodland areas with deer, squirrel, and other game species attract special user groups.

With growing urban populations, public pressure for outdoor recreation opportunities will also increase. Given equal quality of competing areas, recreationists will use those resources closest to them. The valley area will receive light to medium public use pressure from area population centers once new opportunities are provided.

Cultural Resources

A number of cultural resource investigations have been conducted in the Sheyenne River basin for the Corps of Engineers since 1946. Included are two field surveys by the River Basin Surveys of the Smithsonian Institution, a literature search and records review to compile records of all known sites, a cultural resource survey conducted specifically for the Sheyenne River flood control study, an aerial infrared photographic survey to identify areas of high cultural resource potential, and a cultural resource survey of Lake Ashtabula done under the authority of Executive Order 11593. These investigations identified 319 prehistoric and historic sites and 185 prehistoric and historic site leads.

As required by Section 106 of the National Historic Preservation Act of 1966 (Public Law 89-665), as amended, the Corps has consulted the National Register of Historic Places. As of 16 November 1981, one archaeological site, five standing structures, and one historic district in the Sheyenne River valley are listed on the register. None of these sites will be affected by the proposed project. However, further survey and testing of sites may identify additional properties eligible for the register. The Advisory Council on Historic Preservation will be asked to comment in accordance with 36 CFR, Part 800, for all properties listed on or determined eligible for the register that may be affected by the proposed project.

Additional information on cultural resources is in Appendix E.

Institutional Resources

A variety of governmental units ranging from the Federal and State to county, township, and city governments exist in the lower Sheyenne River basin. Zoning regulations are adopted by the communities or by the townships for areas outside of cities, except in the case of Ransom County where zoning is regulated at the county level. The water resource districts (previously called water management districts) are the local political entities with the most authority for water and related land use decisions. Water resource district boundaries correspond to county boundaries, as in Barnes, Richland, and Ransom Counties; however, the Southeast Cass Water Management District includes only the southeastern part of Cass County. Other water resource districts cover the remainder of Cass County.

The regional governments in the lower basin include the Lake Agassiz Regional Council, South Central Regional Council, and the Fargo-Moorhead Metropolitan Council of Governments. These councils serve primarily as clearinghouses for planning activities. They have not enacted any zoning rules or regulations. However, they have been active in assisting townships and other political subdivisions in preparing ordinances and other planning activities.

ANTICIPATED FUTURE RESOURCE BASE (FUTURE "WITHOUT" CONDITION)

Realistic prediction of future conditions requires careful analysis of the existing setting, the trends now developing, and the limitations of the resource base. When determining the effects of any proposed major Federal action, the predicted setting with the proposed project in place must be compared with the setting as it would be without the project. This "with and without project" assessment requires a reasonable estimate of future conditions. The following is a description of the estimated most probable future "without" project condition addressing primarily those areas which are sensitive or related to actions being considered in this report.

Water Resources

Floods will continue to occur in the basin, and the magnitude and frequency may increase if future drainage of wetlands and low-lying areas continues uncontrolled. State law requires permits for drainage of wetlands that have a watershed greater than 80 acres. These permits may not be granted if the drainage will adversely affect downstream interests. Enforcement of the law would prevent any future increases in frequency and/or magnitude of floods as a result of increases in the effective drainage area of the basin. Enforcement of the law, however, would not entirely preclude the drainage of wetland areas and the subsequent loss of natural wetland values. The drainage could take place with the use of gated control structures to regulate when the water is released. Wetland areas will probably continue to be drained with gated control structures used to regulate the effects of this drainage on downstream flood flows.

Low-flow periods can be expected to continue along the Sheyenne River, with water stored in Lake Ashtabula supplementing streamflows during extremely low flows. Since the prolonged drought of the 1930's, only 6 years have had very low runoff. These years were scattered, not consecutive. Although a drought more severe than any experienced since 1940 may occur, the return frequency of this type of drought would be very low. The use of groundwater for irrigation and rural water supply systems will probably

increase, and heavier demands will be placed on groundwater reserves. Communities such as West Fargo where the aquifer levels are dropping may be forced to change to surface water sources.

Increased demands will be placed on both surface water and groundwater resources. Also, increased emphasis will be placed on water conservation measures and improvement of the water quality of the Sheyenne River. The improvement in water quality will depend on the extent of measures taken to improve the quality of runoff from the cropland.

Baldhill Dam will be evaluated under the Dam Safety Assurance Program to determine the modifications necessary to bring the structure into compliance with current criteria. The structure would receive the necessary modifications, subject to congressional appropriations, to bring it into conformance with safety requirements.

Diversion of water into the Sheyenne River through Garrison Diversion Unit facilities depends on the outcome of ongoing consultation between the United States and Canada. The State of North Dakota has proposed a phased development plan for the unit which is designed to address Canadian concerns. Under the proposed plan, the first phase would include completion of Lonetree Dam and Reservoir, the New Rockford Canal, and a 5,000-acre test area at Oakes, North Dakota. The first phase provides for a 20-cubic-foot-per-second flow release for municipal purposes to the Sheyenne River through a canal filter in Lonetree Dam; however, no irrigation is planned in the Sheyenne River basin. Phase II would involve irrigation in the Sheyenne River basin and would depend on demonstrating to Canada that the Boundary Waters Treaty would not be violated. In addition, the Secretary of the Interior is also reviewing a proposal by South Dakota Governor William J. Janklow to deliver water for beneficial use in South Dakota via Garrison facilities. The principal features of the Garrison Diversion Unit which will potentially affect the Sheyenne River are shown on plate 1.

The most likely effect of the Unit's Phase I on the Sheyenne River would be increased and stabilized streamflows in the upper reaches during no- and low-flow periods and changes in water quality. No effects on flood flows are anticipated.

Privately constructed levees which parallel the river will probably continue to be raised and strengthened. Continual confinement of the flood flows will tend to worsen flood conditions downstream of the leveed sections. This adverse effect would be greater when major reaches of the river are confined. Control of the construction of these levees, especially their maximum elevation, and a limit on potential downstream effects may be administered by the State of North Dakota or the water resource districts. Effective control over these private levees will be difficult to administer and will require a strong enforcement effort by the administering body. However, because of the floods in the last several years, more interest is being expressed in preventing persons from taking actions which might worsen the flood problems of others. The construction of private levees falls into this category. Of particular concern is the reach from Kindred to West Fargo.

Environmental Resources

In general, the future environmental setting will be one of reduced quality and quantities. Wetland, woodland, and grassland habitat will continue to be converted to agricultural, residential, and other uses.

Some ongoing draining of wetlands and clearing of woodlands will, over time or by nature of their quality, amount to a significant loss. The wetlands being drained are generally in the upland areas and, once drained, essentially lose their value as fish and wildlife habitat. Although the concern for drainage affecting flood flows downstream will result in stricter controls and regulations on such drainage, it is quite likely that the drainage will continue (although with the use of controlled outlet structures) and that the fish and wildlife values of the wetlands will continue to be lost. Preservation of natural wetland values would require positive action to prevent the drainage. The U.S. Fish and Wildlife Service wetland easement program has been essentially stopped in North Dakota. After some of the political sensitivity of the issues involved in stopping the program lessens, the program will probably be continued. The easement program requires a willing seller to allow the easement to be purchased and, although many wetlands will be preserved through this easement program, there will probably be a net loss of wetland values in the future.

The woodlands being cleared are mostly shelterbelts or valley bottom woodlands. The rate of clearing will probably decrease because much of the land suitable for agriculture has already been put to that use. Losses from residential expansion will probably increase. Vegetation plantings are conducted by State and Federal agencies. In terms of acreage, the amount of clearing is approximately equal to the amount of planting. However, the plantings are usually in the uplands, whereas the clearing occurs in the more ecologically valuable bottomlands.

The principal grassland values in the basin are located in the Sheyenne National Grasslands and in the steeper sloped areas of the basin. The U.S. Forest Service's Environmental Impact Statement indicated that increased emphasis will be placed on management of the Sheyenne National Grasslands for wildlife purposes. Future use of other grassland areas will probably be similar to current use. No significant future changes in grassland values are anticipated.

Human Resources

The education level of residents will increase. The population of the area will increase, although the distribution of people throughout the area will shift. The population of the rural areas should generally be decreasing except in the fringe of the Fargo-Moorhead metropolitan area where scattered rural residential developments will continue to expand.

Economic Resources

The economic base of the basin will remain relatively stable. The agricultural base of the economy will be retained. Changes in crops will be dictated by the agricultural economy, with the most profitable crops being grown in the largest quantities, trending generally toward specialty crops. More processing of raw agricultural commodities will take place in the area. There will be expanded services to the area. Relatively minor changes in total land use will take place, with the acreage in cropland remaining stable. Some land will be lost to urbanization, and some wetland and woodland will be converted to cropland.

Residential development will continue to spread outside of the urban areas. Although most of the rural areas around Fargo-Moorhead are in the floodplain, development will continue in these areas in accordance with floodplain regulations. Most floodplain areas of the basin are governed by regulations that restrict the method of land development to prevent any potential future increases in flood damages. As a result of these regulations, floods up to the magnitude of the regulatory flood will not damage more properties than are currently located in the flood-prone areas. The very large and infrequent floods may pose threats to new developments in floodplain areas.

Recreational Resources

As population and economic growth in the area continues and more leisure time becomes available to individuals, the need for additional recreational development will increase. High gasoline prices will encourage people to consider recreational facilities closer to their homes. Thus, the nearness of the recreation resource to the population centers will become more important.

Cultural Resources

No significant changes from the existing setting are anticipated.

Institutional Resources

Continued emphasis will be placed on State and local management of water resources. More basinwide or watershed control will be needed. Either the existing water resource district organization will be modified or increased coordination will occur between the water resource districts within a watershed area to address more comprehensively the overall water management problems of the entire watershed. The communities of Kindred, Horace, West Fargo, Riverside, and Harwood and rural residential developments from Horace to Harwood will all continue to grow. The city limits of these communities will expand as necessary to provide services to the

developing areas. The development will take place primarily in floodplain areas, and the local enforcement of the floodplain regulations will be instrumental in curbing the growth of future flood damages.

PROBLEMS, NEEDS, AND OPPORTUNITIES

The public and the resource management agencies have identified the problems, needs, and enhancement opportunities associated with water and related land resources. Many of these issues are addressed in this study; however, many are beyond the scope of this study. The level of detail to which the identified problems, needs, and enhancement opportunities are addressed is based on the pertinence and relative priority of the problem, need, or opportunity and its relationship to the objectives and implementing characteristics of this study.

Those Expressed

Members of the public, via a Citizen Input Workshop held on 27 June 1977, expressed their views on the problems and needs of the basin. The following were identified as being of relatively high priority. This list does not necessarily include all major problems nor does inclusion on this list necessarily imply that these issues take precedence over others.

Flooding -

- Residential and commercial floodplain development.
- Uncontrolled drainage.
- Water release problems from Baldhill Dam.
- Drainage problems in the Harwood area.
- Need for hydrologic study of drainage areas.
- Flooding in Red River Valley and basin.
- Control of farmland drainage.
- Overflow of Cass County Drains Nos. 45, 21, and 13.

Water Supply and Water Quality -

- Drainage contributing to degradation of water quality in the lower Sheyenne River basin.
- Need to stabilize flow.
- Need for improved sewage treatment systems.
- Upstream polluters have no concern for downstream neighbors.
- Need to determine causes of poor water quality.
- Need to stop the dumping of dead animals into the Sheyenne River.
- Fort Ransom dumping sewage into river.
- Increased residential building in rural areas is adding to water quality problems.
- Need to preserve natural purificiation areas in the Sheyenne River basin.
- Need to coordinate Garrison Diversion and Sheyenne River planning.
- High water table causes problems (in Sheyenne Delta deposits between Lisbon and Kindred).
- Need to retain surface water supplies.
- Declining underground water supplies (in West Fargo area).
- Bad effects on fish from dissolved solids in Lake Ashtabula.

Recreation, Wildlife, Historical -

- Preservation of sandhill environment.
- Preservation of wildlife habitat.
- Preservation of prairie chicken habitat.
- Preservation of duck habitat.
- Preservation of woodland of Sheyenne River basin.
- Need to reduce conflicts between recreation and other uses.
- Private landowners are liable for accidents on private land and are not compensated for recreational use.
- Need to determine value of small springs coming into the Sheyenne River.
- Need to determine economic value of recreation to area.
- Need to maintain unique areas.
- Need to improve trapping.

In testimony to congressional appropriation committees, several interests, including representatives of the city of West Fargo, Southeast Cass Water Management District, and North Dakota State Water Commission, have testified to the severity of flooding along the lower Sheyenne River and have requested study and implementation of alternatives to resolve these problems. Several interests testifying in opposition to the authorized Kindred Dam project have also recognized the severity of the flood problem; however, they did not feel the authorized project was the best way to solve the problem.

Several other significant needs and opportunities have been expressed:

- Preserve the scenic value of the Sheyenne River from Valley City to Horace.
- Ensure adequate future water supplies at Fargo, Moorhead, and West Fargo.
- Improve recreational opportunities in the region.
- Improve water quality in the Sheyenne River.

Those Addressed

The problems, needs, and opportunities being addressed to varying degrees in this study include:

- Flooding and associated flood problems along the Sheyenne River from Valley City to the confluence with the Red River of the North.
- Potential water supply needs at communities along the Sheyenne River and at Fargo-Moorhead.
- Need to preserve, conserve, or restore fish and wildlife habitat in the lower Sheyenne River basin.
- Need to provide outdoor recreational opportunities in the lower Sheyenne River basin.
- Need to improve water quality of the Sheyenne River.

Priorities

The priority for addressing these problems, needs, and opportunities relates to the authorities of the Corps of Engineers and to the views expressed by representatives of the study area. The principal objective of this study is to resolve the flooding problems of the lower Sheyenne River from Kindred to the mouth of the Sheyenne River. The other purposes are being considered in conjunction with alternatives being evaluated to reduce flood damages. Where possible, multiple-purpose projects are being considered. However, if this study does not help solve the basin's flood problem, it would probably be many years before any positive steps would be taken again to address this problem. Thus, it is imperative that the flooding issue has the highest priority.

PLANNING CONSTRAINTS

Although not absolute constraints, the following are practical constraints which should be considered to the maximum extent practicable in the development of implementable plans.

Sheyenne National Grasslands

Adverse effects on the Sheyenne National Grasslands should be avoided. The grasslands came into existence after the drought of the 1930's turned the sandhills area into a virtual wasteland. The reclamation actions plus the return of normal precipitation patterns turned the area back into a very productive unit. The grasslands are now managed primarily for livestock grazing. The unit has regional and national significance as a grassland area. Several alternatives may affect the grasslands.

Executive Order 11988 - Floodplain Management

The objective of the executive order is to avoid adverse impacts associated with occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The order requires Federal agencies involved

in floodplain activities to avoid the 1-percent chance (base) floodplain, unless it is the only practicable alternative, or to adjust to the base floodplain where it cannot be avoided. All actions considered in this study to reduce flood damages would in some manner affect floodplain activities and, therefore, involve Executive Order 11988. The relationship between this order and the considered alternatives needs to be taken into account in the decision-making process.

Executive Order 11990 - Protection of Wetlands

This order directs Federal agencies to provide leadership in minimizing the destruction, loss, or degradation of wetlands. It states that Federal agencies shall avoid undertaking or assisting new construction located in wetlands unless there is no practical alternative. Many of the considered actions may directly or indirectly affect wetlands. These effects need to be considered in decision making.

Lands Owned and Managed by Federal and State Agencies

Properties under Federal and State ownership and management have had public funds dedicated for their purposes, and adverse impacts on these properties should be avoided as much as possible. Lands in the Sheyenne River basin falling into this category include the Sheyenne National Grasslands, the wetland easement areas of the U.S. Department of the Interior, Federal Wildlife refuges, State game management areas, and Fort Ransom State Park. Any potential adverse effects on these properties should be taken into account. Several alternatives considered could have potential effects on these lands.

Publicly Expressed Concerns over Adverse Impacts from the Relocation of Individuals and the Transfer of Lands from Private to Public Ownership

Much public sentiment has been expressed that actions recommended to resolve the problems being addressed should minimize the number of relocations and the acres of land dedicated to public ownership.

PLANNING OBJECTIVES

The planning objectives of this study are to develop a plan that will provide the best use, or combination of uses, of water and related land resources to meet foreseeable short- and long-term needs of the study area.

The planning objectives listed below are valid for the period of analysis from 1985 through 2035:

- Improve the health, safety, and well-being of residents of flood-prone areas of the lower Sheyenne River basin from Valley City to the confluence with the Red River of the North by reducing flood damages in both urban and rural areas.

- Preserve or enhance the scenic values of the Sheyenne River valley from Valley City to Horace.

- Preserve or enhance the fish and wildlife habitat in the Sheyenne River basin.

- Improve the water quality of Lake Ashtabula and the Sheyenne River downstream of Baldhill Dam.

- Contribute to the well-being of communities and individuals who rely on the Sheyenne River as a water supply by ensuring sustained flow in the river during droughts.

- Contribute to outdoor recreation opportunities in the lower Sheyenne River basin.

- Preserve existing cultural resources in the basin.

- Improve the quality of fish and wildlife habitat and agricultural land by reducing erosion and sedimentation in the lower basin.

CHANGES SINCE THE SURVEY REPORT

Several major changes in the plans of others, the resource base, and public attitudes have taken place since the survey (feasibility) report was completed in 1968. Several of the changes relate directly to issues being addressed in this study.

- The Bureau of Reclamation's Garrison Diversion Unit has undergone several changes in levels of support/opposition, changes in irrigation practices and anticipated effects on water quality of the Sheyenne River and the Red River of the North, and changes in the schedule for implementation. Environmental concerns and Canada have expressed significant opposition because of potential adverse effects. Currently, the effects of the irrigation return flows on the water quality of the Sheyenne River and the Red River of the North are estimated to be significantly less than anticipated at the time of the survey report. The current implementation schedule for Phase I of the unit does not call for irrigation return flows to enter the Sheyenne River. Components being scheduled for Phase I construction center around canals and other components to provide irrigation water within the James River basin. Components of the project are shown on plate 1, with the Phase I components shown as the "first priority" features.

- The resource base, although remaining relatively constant since the late 1960's, has changed in the area of drainage of wetlands and acres of wetlands placed under the wetland easement program. Although the U.S. Fish and Wildlife Service has acquired easements on a large portion of the wetlands in the basin, many wetland areas still are not under easement. Many of these have been drained or are under consideration for drainage. Drainage of wetlands can increase the volume and peak of floods if a normally noncontributing area is made contributing and if that additional flow contribution is added at a time when it will increase the peak. Some changes in the drainage pattern could actually reduce peaks for certain floods. This increase of wetland drainage has resulted in a loss of wetland habitat and has had an unknown effect on floods in the basin.

- Public attitudes on flooding, potential solutions to flood problems, and other related study problems have changed since the late 1960's. Increased public attention has been focused on actions which result in large impacts on nonbeneficiaries. Distributive equity has become a major issue in creating opposition to proposed actions. The credibility of public agencies has also declined since the Kindred Lake project was authorized. However, interest in potential water shortages was stimulated in 1976 and 1977 after a short drought period, and interest in flooding has grown after the 1975, 1978, and 1979 floods. Although limited agreement has been reached on how to resolve the issues, there is widespread support for some resolution. Increased public support has been expressed for preservation of existing environmental values; however, this support has not always been translated into effective programs. Controversies surrounding the Garrison Diversion Unit and wetland easements have stopped the acquisition of further wetland easements.

RESOLUTION OF ISSUES DISCUSSED IN THE PLAN OF STUDY

A summary of the key issues raised during the plan of study for this Phase I GDM and a discussion of the status of their resolution is given below.

Issue: Alternatives to reduce flooding other than Kindred Dam should be investigated.

Status: Many alternatives have been investigated and the results of these investigations are presented in this report.

Issue: A better identification of the existing and anticipated future conditions in the Kindred area "without" the Kindred Lake project is needed.

Status: Additional land use, recreational, and other data have been collected to describe existing and future conditions.

Issue: Impacts associated with the Kindred Dam alternative should be evaluated in greater detail, especially the effects of raising groundwater levels, wildlife losses, pool fluctuations, and water quality problems within the reservoir.

Status: Many aspects of the Kindred Lake project have been investigated in greater detail and used in the evaluation of the Kindred Dam alternatives.

Issue: The need for water-based recreation facilities should be more fully documented since the State Comprehensive Outdoor Recreation Plan (SCORP) shows little need for additional boating acres.

Status: The new SCORP information was used in the assessment of recreation needs.

Issue: Since the timetable for full development of the Garrison Diversion Unit has been changed and its impacts on water quality in the Sheyenne River changed and delayed, the water quality storage components of the authorized Kindred Lake project should be dropped.

Status: Storage of water for the improvement of downstream water quality is not considered a project purpose at this time. The Environmental Protection Agency did not indicate a need for such storage to be included as a project purpose.

FORMULATION OF ALTERNATIVE PLANS

INTRODUCTION

Alternative management measures to address the problems, needs, and opportunities of flood damage reduction, water supply, recreation, fish and wildlife, and water quality were considered individually. The greatest emphasis, however, was placed on flood damage reduction measures, with opportunities for meeting or conflicting with other purposes being recognized. Single-purpose plans for flood damage reduction were similarly developed, recognizing the opportunities for addressing other needs and addressing the conflicts with other purposes. Both structural and nonstructural measures were considered.

MANAGEMENT MEASURES

Flood Control

Measures to address the flooding problems of the basin were identified through past studies; comments of other agencies; public discussion and comments in workshops, meetings, and letters; and interdisciplinary team evaluation. The list of alternative flood damage reduction measures included 102 alternatives ranging from nonstructural measures - such as evacuation and relocation of flood-prone structures, flood proofing, control of drainage, control of private levee construction, hydraulic and hydrologic studies, and others - to structural measures - such as levees, diversions, channelization, snagging and clearing, and reservoir storage. Storage measures included main stem reservoirs on the Maple and Sheyenne Rivers, reservoirs on tributaries to the Sheyenne and Maple Rivers, and increasing wetland storage areas along the Sheyenne River by restoring drained wetlands and increasing the storage capacity of existing wetlands. The list of alternatives considered is presented in table 9. Each of the alternative measures was evaluated to determine its potential effectiveness in reducing flood damages at the various locations in the basin. Then the potential costs, benefits, and environmental and social effects were determined as appropriate. Detailed information on these alternatives can be found in Appendix L, Flood Damage Reduction Alternatives.

Table 9 - Measures considered for flood damage reduction, Sheyenne River basin, North Dakota

Basin-wide drainage plan
Regional/basin-wide approach to water planning
Develop out of floodplain
Better land-use planning
Floodplain zoning
Floodplain regulations
Prohibit replacement of obsolete homes in floodplain
Control private levee construction
Enforce drainage laws
Better legislation to control drainage
Establish greenbelts
Financial incentives to retain water on farmland
Small retention dams
Provide flood insurance
Eliminate flood insurance on future construction
Relocate frequently flooded structures
Evacuate floodplain developments
Flood proofing
Fall release of water from Baldhill Dam
Better management of Baldhill Dam
Urban levees
Valley City
Lisbon
Kindred
Horace
West Fargo
Harwood
Rural levees
Kindred to Horace
Horace to West Fargo
West Fargo to Harwood
Harwood to RRN
Kindred to RRN

Sheyenne River Diversions
M-19 to RRN via Harwood Slough
M-30 to M-24 around W. Fargo via Drain No. 21
M-33 to RRN via Rose Coulee
M-35 to RRN via Sheyenne Diversion
M-42 to Wild Rice River near Horace
M-42 to M-24 via Drain No. 21
M-54 to Wild Rice River near Norman
M-65 to Wild Rice River near Kindred
M-138 to Wild Rice River near Milnor
M-150 to James River via Taayer Reservoir
M-155 to James River via Bear Creek
M-190 to James River via Bear Creek
M-195 to James River via Bear Creek
Maple River diversions
M-6 to RRN via Drain No. 13
M-104 to Sheyenne River via natural valley
Channelize Sheyenne River-Kindred to mouth
Channelize Maple River-Durbin to mouth
Enlarge Cass Co. Drains Nos. 13, 21, and 45
Install retention control structure on drains
Modify bridges and highways
Snag and clear Sheyenne River
Snag and clear Maple River
Snag and clear Sheyenne River tributaries
Restore drained wetlands
Increase storage capacity of wetlands

Dams and reservoirs-Sheyenne River main stem
Kindred (M-76)
Highway 18 (M-86)
Larson's Bridge (M-110)
Strong Memorial Park (M-138)
Lisbon (M-171)
Fort Ransom (M-196)
Baldhill Dam (M-271)
Cooperstown (M-320)
Warwick (M-418)
Dams and reservoirs-Sheyenne River tributaries
(T-83)
(T-94)
Dead Colt Creek (T-150)
Timber Coulee (T-158)
(T-213)
(T-240)
(T-268)
Baldhill Creek (T-283)
(T-304)
(T-308)
(T-321)
Pickerel Lake Creek (T-334)
Lake Norway (T-350)
Kloten (T-366)
McVille Coulee (T-367)
Spring Coulee (T-393)
Robinson Coulee (T-416)
(T-438)
(T-439)
(T-448)
Peterson Coulee (T-453)
(T-460)
Big Coulee (T-463)
North Fork (T-470)
Dams and reservoirs - Maple River main stem
Watson (M-76)
Highland (M-87)
Enderlin (M-106)
Dams and reservoirs - Maple River tributaries
South Branch (T-102)
(T-104a)
(T-104b)
Lucca (T-110)

Water Supply

Existing use and potential future increases in use of Sheyenne River water were evaluated in light of the history of supply and flow in the basin. Analysis of the effects that a recurrence of a 1930's type drought would have on existing and projected uses identified no significant potential shortages at the communities along the Sheyenne River or at Fargo-Moorhead, which relies in part on the Sheyenne River for a source of supply. The probable increase of base flows in the Sheyenne River as a result of diversion of Missouri River water via the Garrison Diversion increases the reliability of existing supplies to accommodate future increased demands. Water supply shortage is not seen as a major water resource problem for the basin. Additional information on water supply in the basin is presented in Appendix M, Plan Formulation.

Fish and Wildlife Resources

The woodlands, grasslands, and wetlands of the Sheyenne River basin provide important wildlife habitat to a great number of species. Although the Sheyenne National Grasslands provides a large and concentrated acreage of grassland habitat, the Sheyenne River valley has limited woodland area except in the river valley and coulee areas. A fairly large acreage of wetlands is still present in the basin. However, the pressures to clear woodlands and to drain wetlands will tend to reduce fish and wildlife values in the future. Alternative measures to preserve and/or enhance fish and wildlife resources are listed in table 10. These measures were considered for potential incorporation or addition to flood control measures and plans. More detailed information on these measures can be found in Appendix D, Environmental Resources.

Table 10 - Alternative measures considered to preserve or enhance the fish and wildlife resources of the Sheyenne River basin

- Determine the value of small springs coming into the Sheyenne River
- Determine the value of natural vegetation in the Sheyenne River basin
- Inventory unique areas in the basin
- Reactivate the soil bank program
- Implement a program for the preservation and management of existing wetlands
- Implement a program for the construction of small retention dams
- Encourage the planting of more shelterbelts
- Develop gree elt areas along rivers
- Implement a program for the preservation and management of existing woodlands
- Encourage the designation of the Sheyenne River as a Wild and Scenic River
- Implement the State Nature Preserves program in the Sheyenne River valley
- Encourage participation in the water bank program
- Implement a program to improve the water quality of the Sheyenne River and Lake Ashtabula
- Develop wildlife management plans for the basin
- Develop plans to preserve unique areas in the basin
- Develop a forestry management plan for the basin
- Develop a land-use plan for the basin
- Encourage use of more land treatment measures
- Improve low-flow characteristics of streams
- Restore drained wetlands and increase the size of existing wetlands
- Provide in-stream structures for fishery enhancement

Recreation

Water-based outdoor recreation opportunities in the lower basin are quite limited, and future demands for these activities are expected to exceed the supply. Alternatives considered to meet these needs included major water-oriented developments, water-related activities, and interpretive features. Those alternatives with potential for development in conjunction with a flood control plan were emphasized. Additional information is presented in Appendix I, Recreation Resources Analysis.

Other Purposes

Hydropower development in the basin was given very limited consideration because of the low sustained flows and low head potential on the Sheyenne River.

Preservation and/or enhancement of cultural resources were also considered only in a limited manner, primarily in their relationship to flood damage reduction alternatives.

Improvement of Sheyenne River and Lake Ashtabula water quality was considered as it related to flood damage reduction alternatives. Alternatives that related solely to general improvement of water quality were not considered.

PLAN FORMULATION RATIONALE

The rationale used in plan formulation follows U.S. Water Resources Council's Principles and Standards and Corps of Engineers regulations. This rationale uses an iterative process of problem identification, alternative development, impact assessment, and evaluation.

The screening process has been done essentially in three stages with local, State, and Federal agency and public input being used to assist in the process. In stage 1, the flood damage reduction measures were evaluated individually according to economic, environmental, and implementability criteria and were considered for their potential for inclusion into plans. A discussion of the process and the ratings given the measures are presented in Appendix M, Plan Formulation. After completion of the stage 1 screening process, additional data were collected on the remaining alternatives.

Using the supplemental data, the alternative measures were combined into plans using different philosophies or approaches to meeting the flood damage reduction objective. The descriptions of the plans, discussion and display of their relative merits, and conclusions reached by an interdisciplinary team were presented for agency and public review. Agency and public comments as well as additional data were used in the development of the final array of flood damage reduction plans.

The plans were formulated to meet the objective of reducing flood damages to flood-prone residential, commercial, and industrial developments and agricultural land along the Sheyenne River. Because of the high percentage of total average annual flood damages attributable to the developments, the plans emphasized reductions of these types of damage. Agricultural protection was included in the plans wherever possible. Plans were sized to provide reasonable degrees of flood protection and features were selected which would not provide a false sense of security for residents being protected by the plan. Although several of the plans would reduce flood damages along the Red River of the North, such reductions were not considered essential to the plans. However, the plans were carefully formulated so that none of them would worsen flood damages along the Red River.

The flood control plans presented could include other purposes at limited levels of development, in keeping with the planning objectives for these purposes. However, plans were not developed with the intent that all planning objectives would be fully met.

PLANS OF OTHERS

The Ransom County Water Resource District - in conjunction with the North Dakota State Water Commission, and other State, regional and local interests - is planning a dam and lake on Dead Colt Creek near Lisbon. The principal purpose of the lake is to provide water-based recreational opportunities. However, because this site is one of the tributary damsites considered for flood control storage which has significant potential for adding net positive benefits to a flood damage reduction plan, flood control storage has been added as a project feature so that the project will be multipurpose. Planning, design, and operation of

the project are being coordinated and should continue to be coordinated with other water management plans and project.

The U.S. Forest Service has prepared a Land Management Plan for the Sheyenne National Grasslands. This plan covers lands owned and managed by the Forest Service. Few of these lands would be affected by any of the proposed actions, although the Kindred Dam and Lake alternative could affect some of the grasslands.

The Garrison Diversion Unit has the greatest potential for effects on the Sheyenne River in the area of low-flow augmentation. The Unit could improve the low-flow characteristics of the stream for the fishery and water supply purposes. Future work that relates to the Sheyenne River drainage area should be coordinated with water management projects and plans in the Sheyenne River basin.

DEVELOPMENT OF PRELIMINARY ALTERNATIVE PLANS

Many of the measures listed in table 9 were dropped from further consideration in the first screening process. From those measures carried into stage 2, seven alternative plans were developed and evaluated for their relative merits. These plans were formulated recognizing the need to meet the objectives of improving the health, safety, and well-being of floodplain residents by reducing flood damages and providing opportunities to meet other related needs where possible. In the development of all plans, three actions were considered essential for implementation by non-Federal interests: (1) continuation (or adoption if needed) and enforcement of floodplain regulations, (2) control of private levee construction, and (3) control of future drainage. Also, the continued availability of flood insurance for developments in floodplain areas was also considered important. The plans developed used two key alternatives as the basis for the building of the plans: local protection at West Fargo or the large flood control reservoir near Kindred. Starting with one of these two components, plans were formulated to reduce basin flood damages emphasizing either potential environmental quality objectives, national economic development objectives, or a combination of the two and recognizing that the plans must be meaningful and implementable, yet different enough to provide some true options.

Seven preliminary plans were formulated. The plans and their components are listed in table 11. Four of the plans contained the levees and flood diversion channel at West Fargo as a key component; these plans are labeled D-1 through D-4. The other three plans used the Kindred Dam as the key component, plans K-1, K-2, and K-3.

Assessment and Evaluation of Preliminary Plans

The preliminary plans and their component measures were assessed for their effects and impacts and evaluated for their relative contributions to the planning objectives. Table 12 presents a summary of the relative merits of the preliminary plans. Additional details on the evaluations of the plans can be found in Appendix M, Plan Formulation. The information on these plans was used to draw conclusions and then the data and conclusions were furnished to other agencies and the public for their review and comment. Plan D-2 was listed as the candidate national economic development (NED) plan and also as the candidate environmental quality (EQ) plan (or perhaps more appropriately labeled as the environmentally least damaging plan). Plans D-1 and K-3 both had positive economic net benefits and if various components of the plan were shifted a change in the NED plan could result. Similar changes in the EQ account could result between plans D-1 and D-2.

Public and Agency Response to Preliminary Plans

Letters of comment were received in response to the preliminary plans from nine Federal agencies, six State agencies, five cities, eight water management districts and counties, eight organizations, and five individuals. Table 13 summarizes these comments. The table shows if the comments include a specific recommendation to keep or drop any of the three plans recommended for further study in the stage 2 report and summarizes any specific remarks.

Table 11 - Flood damage reduction plans for the Shevenne River, North Dakota[1]

Plan D-1	Plan D-2	Plan D-3	Plan D-4	Plan K-1	Plan K-2	Plan K-3
Levees and diversion around West Fargo (M-30 to M-24)	Levees and diversion around West Fargo (M-30 to M-24)	Levees and diversion around West Fargo (M-30 to M-24)	Levees and diversion around West Fargo (M-30 to M-24)	Kindred Dam (near site capacity - about 360,000 acre-feet of storage)	Kindred Dam (reduced size - about 180,000 acre-feet of storage)	Kindred Dam (reduced size - about 180,000 acre-feet of storage)
Diversion to the Wild Rice River (M-54) with about a 2,000-cfs design	Diversion from Horace to West Fargo (M-42 to M-30)	Raise of Baldhill Dam (5 to 15 ft.)	Channelization of Sheyenne River from Kindred to West Fargo	Revised management of Baldhill Dam	Raise of Baldhill Dam (5 to 15 feet)	Diversion to Wild Rice River (M-65) with a design of about 2,000 cfs
A revised management and/or a raise of Baldhill Dam (up to a 5 foot raise)	Revised management of Baldhill Dam	Restoration of drained wetlands, increase storage capacity of existing wetlands, and/or put control structures on legal drains from Baldhill Dam to Kindred	Revised management of Baldhill Dam		Diversion of the Maple River to the Red River of the North	Rural levees from Kindred Dam to diversion channel at M-65
Tributary dams T-150 Dead Colt Creek[2] T-158 Timber Coulee	Relocation of frequently flooded residences at Valley City	Tributary dams T-150 Dead Colt Creek[2] T-158 Timber Coulee	Tributary dams T-150 Dead Colt Creek[2] T-158 Timber Coulee			Revised management of Baldhill Dam
Restoration of drained wetlands, increase storage capacity of existing wetlands, and/or put control structures on legal drains from Baldhill Dam to Kindred	Ring levees at farmsteads and residences from Kindred to Horace, and from West Fargo to the mouth		Restoration of drained wetlands, increase storage capacity of existing wetlands, and/or put control structures on legal drains from Baldhill Dam to Kindred			
			Ring levees at farmsteads and residences from West Fargo to the mouth			

(1) All plans used as a basic assumption that:
- a) Adequate floodplain zoning and regulations exist and are enforced.
- b) Flood insurance is available in floodplain areas.
- c) Private levee construction will be controlled.
- d) Existing drainage laws will continue and will be enforced.

Also, these plans can be modified consistent with the national objectives of National Economic Development and Environmental Quality.

(2) Using Dead Colt Creek as a multiple purpose project with about 5,000 acre-feet of flood control storage available.

Table 12 - Summary of relative merits of flood damage reduction plans

Comparison items	Plan						
	D-1	D-2	D-3	D-4	K-1	K-2	K-3
Reduction of flood damages	Moderate	Moderate	Moderate to high	Moderate to high	High	Moderate to high	Moderate to high
Positive contribution to national economic development	Yes	Yes	Marginal	Marginal	Marginal	No	Yes
Positive contribution to environmental quality	Maybe	Maybe	No	No	No	No	No
Positive contributions to social well-being	Moderate	Moderate	Moderate	High	High	High	High
Potential adverse social impacts	Moderate	Moderate	Moderate to high	Moderate	High	High	High
Potential adverse environmental impacts	Low	Low	Low to moderate	Moderate	High	High	High
Potential to add purposes to plan							
Water supply	Yes	-	Yes	"es	Yes	Yes	Yes
Recreation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fish and wildlife	Yes	-	Yes	Yes	-	-	-
Cultural resources	Limited	Limited	Limited	Limited	Limited	Limited	Limited
Water quality	-	-	-	-	-	-	-
Potential to preclude other objectives	Limited	Limited	Limited	Limited; some on scenic river	Scenic river; others	Scenic river; others	Scenic river; others

Table 13 - Summary of comments received on stage 2 report, preliminary plans

COMMENTING PARTY	PLAN D1	PLAN D2	PLAN K3	REMARKS/OTHER COMMENTS
FEDERAL AGENCIES				
Department of Agriculture Forest Service	N	K	D	Need more information about K-3 to assess impacts on Sheyenne National Grasslands.
Department of Agriculture Soil Conservation Service (Bismarck)	N	N	N	SCS participation in the implementation of tributary dams requires analysis by Principles and Standards. Must have local sponsorship.
Department of Commerce National Weather Service	N	N	N	No significant issues, resources, or impacts have been omitted.
Department of Health and Human Services	N	N	N	Any proposed flood control project should be an overall benefit.
Department of Interior Fish and Wildlife Service (Bismarck)	D	K	D	Plan D-2 with wetland restoration added is favored.
Department of Interior National Park Service	N	N	N	No National parks affected; no comment.
Department of Interior Water and Power Resources Service	N	N	N	Water quality discussions need more documentation.
Environmental Protection Agency	N	N	D	Favor water quality improvement of Lake Ashtabula. No water quality storage needed at Kindred Dam or Baldhill Dam.
Federal Energy Regulatory Commission	N	N	N	Raise of Baldhill Dam and/or Kindred Dam would provide small hydroelectric potential. Development of this hydroelectric potential does not appear economically feasible.

K - KEEP FOR FURTHER STUDY
D - DROP FROM FURTHER STUDY
N - NO RECOMMENDATION STATED

Table 13 - Summary of comments received on stage 2 report, preliminary plans (cont)

COMMENTING PARTY	PLAN D1	PLAN D2	PLAN K3	REMARKS/OTHER COMMENTS
STATE AGENCIES				
North Dakota Forest Service	N	K	N	Plan D-2 has the least impact on woodlands.
North Dakota Game and Fish Department	K	K	D	Favor some type of diversion plan. Add restoration of drained wetlands to areas above Baldhill Dam.
North Dakota State Highway Department	N	N	N	Impacts of transportation facilities from local through State systems need further study.
North Dakota State Water Commission	K	K	K	Further studies should be conducted on plans D-1, D-2, and K-3. Consideration should also be given to a combination of plans D-1 and D-2, in which small upland water retention dams would be included. Specific views on components of the plans will be provided after more detail is available.
State Historical Society of North Dakota	N	N	N	Evaluations are provided based on standpoint that the area of total land disturbance by each plan is an indication of cultural resources affected.
Minnesota Pollution Control Agency	N	N	N	No comment at this time.
CITIES				
City of Casselton	N	N	N	No comment at this time on flood control plans. More concerned about potential future drought conditions.
City of Grand Forks	D	D	K	Prefer original authorized Kindred Dam project; however, would favor plan K-3 with addition of a small conservation pool.

K - KEEP FOR FURTHER STUDY
D - DROP FROM FURTHER STUDY
N - NO RECOMMENDATION STATED

Table 13 (cont)

COMMENTING PARTY	PLAN D1	PLAN D2	PLAN K3	REMARKS/OTHER COMMENTS
CITIES (continued)				
City of Valley City	N	N	N	Do not support relocation of flood-prone structures within Valley City. Favor revised management and/or raise up to 5 feet of Baldhill Dam.
City of West Fargo	K	K	K	Plans D-1 and D-2 appear to address mainly West Fargo's problems and do not solve the problems downstream. Costs of plans D-1 and D-2 appear to be too low.
WATER MANAGEMENT DISTRICTS				
Barnes County Water Management District (Russell McKay)	K	K	N	Favor the installation of small holding dams, diversion of the Wild Rice into the Red River, and diversion ditches and dikes around West Fargo.
Barnes County (Lester Abraham)	N	N	N	Do not favor any raise of Baldhill Dam. Favor small dams and revised management of Baldhill Dam. All drainage should be controlled drainage.
Red River Joint Water Management Board	K	K	D	Favor addition of small upland water retention dams as part of plans D-1 and D-2. Do not recommend plan K-3 for any further studies.
Richland County Water Management District (Jorgen Haugen)	N	K	D	D-2 is favored with some changes.
Rush River Water Management District (Ken McIntyre)	N	K	D	Plan D-2 is favored with some modifications including diversions to the Red River of the North at miles 35 and 19. Favor up to 5-foot raise of Baldhill Dam and support construction of small retention dams.
Ransom County Water Management District				

K - KEEP FOR FURTHER STUDY
D - DROP FROM FURTHER STUDY
N - NO RECOMMENDATION STATED

Table 13 (cont)

COMMENTING PARTY	PLAN D1	PLAN D2	PLAN K3	REMARKS/OTHER COMMENTS
WATER MANAGEMENT DISTRICTS (cont.)				
Southeast Cass Water Management District	K	K	K	Favor protection for larger floods. If a diversion plan is to be viable, consideration should be given to substantial reclamation of wetlands, control drainage and diking, and active program of ring levees. Many concerns on diversion plans must be answered before plan is acceptable.
ORGANIZATIONS				
Lower Sheyenne River Citizens Committee	K	K	D	No new drains without controls and reassess existing drainage for controls. Monitor and regulate any private levee construction which might affect river levels at Horace and downstream points.
North Dakota Farm Bureau	N	N	D	Favor a series of small dry dams throughout the basin.
North Dakota Township Officers Association	K	K	D	Favor a series of dikes, channelizing and small retention dams.
Pleasant Township (Mr. Jerome Nipstad)	D	K	D	Against any diversion to Wild Rice River.
Richland County Farm Bureau	N	N	D	Strongly oppose Kindred Dam.
Sheyenne Valley Association	K	K	D	D-2 is favored with no relocations at Valley City.
Sheyenne Valley Grazing Association	K	K	D	D-2 is favored with some modifications.

K - KEEP FOR FURTHER STUDY
D - DROP FROM FURTHER STUDY
N - NO RECOMMENDATION STATED

Table 13 (cont)

COMMENTING PARTY	PLAN D1	PLAN D2	PLAN K3	REMARKS/OTHER COMMENTS
OTHER				
"The Forum" Fargo-Moorhead Newspaper	D	D	K	Strong support for upstream storage, including use of the Kindred site.
Mr. Greg Doffin	K	K	D	Favor ring levees for areas downstream of West Fargo as well as between West Fargo and Horace.
Michael L. Gregg (University of North Dakota)	N	N	N	Concerns and interests relate to identification and protection of important cultural resources lying in areas where landscape modifications will be made to implement a plan.
Mr. Larry Richard and Mr. George Richard	D	N	D	Against any diversion to Wild Rice River.
Mr. R. Joseph Sether	D	D	K	Favor the upstream storage of flood waters. Not in favor of diversions.

K - KEEP FOR FURTHER STUDY
D - DROP FROM FURTHER STUDY
N - NO RECOMMENDATION STATED

Comments received on individual plans, components of the plans, and/or project purposes as presented in the stage 2 report are summarized in the following paragraphs.

Plan D-1 -

1. Interests along the routes of the diversions to the Wild Rice River (Pleasant Township, Mr. Larry Richard, and Mr. George Richard) oppose any diversion to the Wild Rice River.

2. Interests along the Red River of the North (city of Grand Forks and the editor of the Fargo-Moorhead Forum) believe the diversions to the Wild Rice River and Red River of the North and the other diversions do not contribute to the solution of the flooding problems of the Red River and should be dropped in favor of storage alternatives.

3. The U.S. Fish and Wildlife Service expressed concern over the adverse impacts of the storage elements of plan D-1.

Plan D-1 was generally supported for further consideration, although the viability and/or implementability of several of the plan's components were questionable. The plan's concept was generally supported but modifications were suggested for further studies.

Plan D-2 - Although only three of the letters received favored dropping the diversions and other components of plan D-2 (the city of Grand Forks, the Forum, and Mr. R. Joseph Sether), many expressed concern about the viability of the plan. Most of the letters supported keeping plan D-2 or a modification for further evaluation.

Plan K-3 - Most of the comments received on this plan recommended dropping it from further consideration. These views were expressed by the U.S. Forest Service, U.S. Fish and Wildlife Service, Environmental Protection Agency, North Dakota Game and Fish Department, the Red River Joint Water Management Board, the Lower Sheyenne River Citizens Committee,

and many others. The major concerns with this plan were the large acreages of land required and the effects on the relocated residents and the local tax base, woodland and wildlife in the project area, and groundwater levels.

Recommendations that plan K-3 should be carried for further study came from the North Dakota State Water Commission, the city of Grand Forks, the city of West Fargo, the Southeast Cass Water Management District, the Forum, and Mr. R. Joseph Sether.

Other Plans - The North Dakota State Water Commission and the Red River Joint Water Management Board both requested consideration of a plan that would combine the features of plans D-1 and D-2 with small upland water retention dams. Comments from other agencies and interests also suggested the modification of plans D-1 and D-2.

Components of the Plans -

1. Baldhill Dam - Valley City indicated its preference for revised management of Baldhill Dam and a raise of not more than 5 feet as the method for reducing potential flood damages in the city. Barnes County, however, opposed any raises requiring acquisition of lands. Other interests also commented on the raise of Baldhill Dam.

2. Tributary Dam: Timber Coulee - The city of Lisbon, Ransom County, and the Ransom County Water Management District all recommended dropping the Timber Coulee site from further consideration or changing its location.

3. Tributary Dam: Dead Colt Creek - The city of Lisbon, Ransom County, and the Ransom County Water Management District indicated that the Dead Colt Creek dam should be built as a multiple-purpose project including storage for flood control.

4. Relocation of Frequently Flooded Structures at Valley City - Valley City does not support the relocation of flood-prone structures. No favorable responses were received concerning the relocations at Valley City.

5. Wetlands - The U.S. Fish and Wildlife Service indicated it would cooperate in a wetland restoration/wetland size increase program if wildlife resources were adequately considered. The Bureau of Reclamation indicated the possibility of acquiring and restoring drained wetlands in the Sheyenne River basin as part of a wildlife mitigation plan for the Garrison Diversion Unit. These restored wetlands could also provide flood control storage. The North Dakota Game and Fish Department would like to extend the area for restoration of wetlands beyond the reach from Kindred to Baldhill Dam. The department believes the drainage area above Baldhill Dam should also be considered.

6. Control of Drainage - The Lower Sheyenne River Citizens Committee passed a resolution asking the North Dakota State Water Commission to ensure that all future drainage projects be controlled so as to not increase downstream flood problems and that existing drainage projects be reassessed to determine if additional controls are needed. The North Dakota State Water Commission stated that Section 61-02-02 of the North Dakota Century Code requires that drainage of a watershed of 80 acres or more must have a permit from the State Engineer and the appropriate water management district and that all drainage in the Red River of the North basin is of statewide significance requiring final approval by the State Engineer. Enforcement is often difficult; however, reorganization of the water management districts could strengthen this enforcement. Water management districts and others also discussed the need for control of drainage in the basin.

7. Control of Private Levee Construction - The North Dakota State Water Commission commented that Section 61-16-15 of the North Dakota Century Code requires permits for dikes that contain more than 12.5 acre-feet of water (all dikes along the Sheyenne River would be included). This regulation is not easy to enforce. However, the water management districts and water commission are attempting stricter enforcement. The ability of the water management districts and water commission to effectively control these private levees is essential to development of any levee and diversion plan for the lower Sheyenne River to ensure that a meaningful degree of flood protection can be provided.

Water Resource Management and Related Purposes -

1. Flood Damage Reduction - When commented on at all, flooding and flood damages along the lower Sheyenne River were generally recognized as a major problem. The Soil Conservation Service commented that the statements of the flooding problem should be clarified.

2. Water Supply - Existing and future water supply needs as discussed in the stage 2 report were addressed only by the Bureau of Reclamation and Valley City. The Bureau indicated that more than 60,000 acres of potentially irrigable land is located in the area of the Kindred reservoir site and that the potential water needs of this land should be recognized in the analysis of water needs. Valley City indicated its concern with adequate water storage for Valley City's future needs if the management of Baldhill Dam were to be revised without proper consideration for potential water shortages during severe droughts.

3. Water Quality - The Bureau of Reclamation indicated its concern over the adequacy of the water quality information in the report. The U.S. Environmental Protection Agency (EPA) indicated no foreseeable need for storage at either the Kindred Dam site or Baldhill Dam for water quality improvement. The EPA indicates that opportunities to improve the water quality in Lake Ashtabula should be considered.

4. Recreation - The city of Grand Forks commented that a small permanent pool should be considered in plan K-3 to improve recreation potential. No one else commented on the recreation needs or potentials of the study area.

5. Hydroelectric Power - The Federal Energy Regulatory Commission provided information on the potential for hydropower at the Kindred Dam site and Baldhill Dam. The Commission's analysis showed small potential for the development of hydropower; it does not appear to be economically feasible to develop the power potential at these sites.

6. Fish and Wildlife - The U.S. Forest Service indicated there are opportunities for improving wildlife habitat on the Sheyenne National Grasslands, but no specific proposals are being considered for implementation. The Fish and Wildlife Service, Environmental Protection Agency, and North Dakota Game and Fish Department indicated that the potential for the restoration of drained wetlands should be investigated further with the possibility of improving wildlife habitat.

7. Cultural Resources - The State Historical Society of North Dakota and Michael L. Gregg, University of North Dakota, commented that additional information should be gathered in potential project areas to ensure that cultural resources are considered when any project is developed.

Conclusions on Stage 2 Report and Preliminary Plans

On the basis of analysis of the Stage 2 Report findings and the comments and responses received from interested parties, several conclusions were reached on the plans to be carried the final evaluations.

1. Joint-Coordinated Actions by Federal, State, and Local Agencies - For any plan to resolve flood problems in the basin, there must be a joint and fully coordinated effort by Federal, State, and local agencies to address the issues and the solutions. The magnitude and extent of the problem require the commitment of resources which exceed the capability of the State and local interests. Although Federal agencies can provide the resources to analyze problems and implement some elements, they do not have the authority to implement many of the elements needed to make any effective long-range plan function. Commitments are required at all three levels to resolve the issues. Failure by any one of the levels will result in either complete failure of the plan or, at best, implementation of an incomplete plan.

2. Individual Flood Damage Reduction Measures are Needed to Form a Viable Plan - The flood damage reduction measures carried into the stage 2 process should be considered in subsequent planning as discussed in table 14.

The sizes and operating characteristics of the individual alternatives must be considered in terms of the overall plan. For example, the diversion to the Wild Rice River (M-54) must be operated as a part of plan D-1 or potentially as a part of plan K-3. The size of the diversion and the operating plans for the diversion would be different in the two plans. The following points are of particular concern:

a. Baldhill Dam - Revised management or a raise of up to 5 feet could be considered as a possible addition to almost any comprehensive flood control plan. However, most of the benefits would be in Valley City. This measure appears to be one of the few viable to reduce flood damage at Valley City.

b. Kindred Dam - This flood damage reduction alternative is one of the most effective. Its widespread benefits would include downstream areas along the Red River of the North. However, it would have major environmental and social impacts. These adverse impacts would have to be minimized for this alternative to be considered implementable.

c. Tributary Dams: Dead Colt Creek - This dam has potential to reduce the first peak on the Sheyenne River and could be used in conjunction with diversion plans D-1 and D-2: as an integral part of plan D-1, or as supplemental protection in plan D-2.

d. Levees and Diversion at West Fargo/Riverside - This alternative would efficiently protect West Fargo/Riverside while having few or no adverse effects on surrounding areas. It forms the nucleus for several different diversion plans.

e. Ring Levees at Individual Farmsteads and Residences - These levees could supplement all plans in those areas where a widespread form of flood protection cannot be provided by other means.

f. Better Land-Use Planning - There is no good substitute for effective land use planning. Putting the land to its most beneficial uses will provide maximum benefit in the long term. This practice should be used to the extent possible, incorporating many approaches to proper management of flood-prone areas.

Table 14 - Summary of conclusions on flood damage reduction measures considered in Stage 2

Measures carried into Stage 2	Conclusion for incorporation into Stage 3 plans	Remarks
Measures that could be considered part of the existing and future base conditions		
Basinwide drainage plan	Keep	For State planning to ensure no future worsening of floods.
Regional basinwide approach to water planning	Keep	Needed to ensure a complete comprehensive plan is implemented.
Better land-use planning	Keep	At local level to promote wise land use and minimize flood losses.
Floodplain zoning	Keep	For all new construction and remodeling at local level.
Floodplain regulations	Keep	For all new construction and remodeling at local level.
Control private levee construction	Keep	At local and State level to ensure flood stages are not worsened in other areas.
Enforce drainage laws	Keep	At State and local level.
Provide flood insurance	Keep	At Federal level to assist existing development; should be in combination with floodplain regulations.
Measures that could be considered minor components of an overall plan		
Develop out of floodplain	Keep	At local level to minimize potential flood losses (practical in only a few areas).
More stringent legislation to control drainage	Keep	Could be adopted at State or local level; current laws appear sufficient if enforced.
Financial incentives to retain water on farmland	Drop	Would require new Federal or State programs; similar effects can be obtained through drainage control.
Small retention dams	Keep	Similar to effects obtained by control of drainage, the restoration of wetlands; local implementation.
Relocate frequently flooded structures	Keep	For possible Federal participation at Valley City; for State or location participation in other areas (as part of a nonstructural plan).

Table 14 - Summary of conclusions on flood damage reduction measures considered in Stage 2 (cont)

Measures carried into Stage 2	Conclusion for incorporation into Stage 3 plans	Remarks
Measures that could be considered minor components of an overall plan (cont)		
Flood proofing	Keep	On an individual case basis; this measure includes ring levees at farmsteads and residences in rural areas.
Revised management of Baldhill Dam	Keep	Greater spring drawdowns for flood control; care must be taken not to jeopardize low-flow storage.
Urban levees at Harwood	Drop	Costs exceed apparent benefits.
Rural levees from Horace to West Fargo	Drop	Although marginally feasible when considered alone, the diversion paralleling the Sheyenne River appears better suited.
Rural levees from West Fargo to Harwood	Drop	Costs exceed apparent benefits; could be some worsening of downstream flood levels; individual ring levees more favorable.
Rural levees at selected reaches from Kindred to the Red River	Drop	Ring levees at farmsteads and residences are preferred.
Maple River diversion M-6 to Red River via drain No. 13	Drop	Costs exceed apparent benefits; principal benefits come from lower Sheyenne River north of West Fargo.
Enlarge Cass County drains Nos. 13, 21, and 45	Drop	Enlargement of drain No. 21 in conjunction with diversion plans D-1 and D-2 only.
Install retention control structures on drains	Keep	At local level a coordinated control plan for drains could provide some reduction in flooding.
Modify bridges and highways	Keep	At local level these could reduce localized flood problems.
Snag and clear the Sheyenne River	Keep	Should be accomplished after major flood events to keep channel clear; local implementation.
Restore drained wetlands	Keep	Could benefit downstream interests especially as part of plans D-1 and D-2.

Table 14 - Summary of conclusions on flood damage reduction measures considered in Stage 2 (cont)

Measures carried into Stage 2	Conclusion for incorporation into Stage 3 plans	Remarks
Measures that could be considered minor components of an overall plan (cont)		
Increase storage capacity of wetlands	Keep	Could benefit downstream interests especially as part of plans D-1 and D-2.
Tributary dams:		
Iron Springs (T-94)	Drop	Costs exceed apparent benefits.
Dead Colt Creek (T-150)	Keep	Could be effective as a part of plans D-1 and D-2.
Timber Coulee (T-158)	Drop	Although it could be effective as a part of plans D-1 and D-2, has substantial opposition and no local support.
T-240	Drop	Costs exceed apparent benefits.
Maple River main stem dam (M-106) near Enderlin	Drop	Costs exceed apparent benefits; levee protection is more practical at Enderlin.
Measures that could be considered major components of an overall plan		
Levee and diversion M-30 to M-24 around West Fargo	Keep	A major component of plans D-1 and D-2.
Sheyenne River diversion M-42 to Wild Rice River	Drop	Drop in favor of M-54 or M-65; however, could replace M-54 as part of plan D-1.
Sheyenne River diversion M-42 to M-24 via drain No. 21	Keep	A supplemental component of plan D-2.
Sheyenne River diversion M-54 to Wild Rice River	Keep	A supplemental component of plan D-1 and possibly plan K-3.
Sheyenne River diversion M-65 to Wild Rice River	Keep	A supplemental component of plan K-3.
Channelize Sheyenne River, Kindred to mouth	Drop	Is not as desirable as other plans.
Kindred Dam (M-76)	Keep	A major component of plan K-3.
Raise Baldhill Dam (M-271)	Keep	Keep up to a 5-foot raise as part of plans D-1, D-2, K-3, or other plans.

3. Basic Elements of Any Plan - Several elements are considered essential to prevent increases in flood damages and ensure the viability of any comprehensive flood damage reduction plan. These components include existence and enforcement of floodplain zoning and regulations, control of private levee construction, and continuation and enforcement of existing drainage laws.

The floodplain regulations and zoning should be used to ensure that future construction in flood-prone areas is consistent with true flood risk and will not require corrective action. A control system should be established for private levee construction to minimize the adverse effects of levees on flood levels on other properties. The regulation of drainage must be enforced to ensure that future drainage does not worsen flood conditions. The floodplain regulations, drainage regulation, and control of private levees require involvement and implementation by State and local interests. All of these actions are necessary to deal with Sheyenne River flood problems.

4. Any Comprehensive Plan Should Include Either the Kindred Dam or Local Protection in the West Fargo Area - In addition to measures taken to ensure that flood damage potential is not increased, a comprehensive plan must significantly reduce flood damage potential of existing flood-prone developments. A comprehensive plan which addresses this need should include either the Kindred Dam or local protection at West Fargo/Riverside. The West Fargo/Riverside area, the major urban center, contains over 50 percent of the potential flood damages and is subject to flooding from two peaks on the Sheyenne River and the backwater effects of the Maple, Rush, and Red Rivers. Use of upstream reservoir storage would require a dam at the closest point to the damage to be able to control both peaks and, during the first peak, reduce the flow to zero. This location would be near the Kindred Dam site. If major upstream reservoir storage is not used, some form of levee protection must be used. The most cost-effective and least disruptive levee plan identified consists of the combination of levees and diversion channel around West Fargo/Riverside. Other plan components could be added to reduce flood damages over larger areas of the basin.

5. Variations of Plans D-1, D-2, and K-3 Merit Further Consideration - The three plans do not appear to be widely supported without some modifications. The diversion-oriented plans received much more widespread support than did the Kindred Dam plan. Plan K-3 received very limited support; however, it should be considered further because it is economically viable and represents a "nonlevee" alternative.

6. Opportunities to Meet Other Water Management Purposes and Needs Could be Considered in Conjunction with the Plans Evaluated Further - The meeting of the other needs does not appear to be an overriding factor in plan selection. Plan selection should be based primarily on the capability of the plan to reduce flood damages. Project additions or modifications to meet other objectives (such as water supply, water quality, and recreation) should be considered on a case-by-case basis and the positive and negative effects should be displayed for consideration in plan selection. Potential water supply shortages do not appear significant; at least, additional major reservoir storage does not appear necessary. Water-based recreation needs have relatively low priority and could best be met by smaller impoundments.

7. Non-Federal Interests would be more Effective in Implementing Their Portions of an Overall Water Management Plan if They had Jurisdiction Over the Entire Watershed - Water resource districts, which are generally organized on the county basis, have little incentive to consider interests outside their jurisdiction. Although they may consider potential adverse effects downstream, potential projects that benefit other areas are quite often given very limited consideration. A watershed approach to planning, decisions, and implementation could result in better water management for the entire area.

DEVELOPMENT OF FINAL PLANS

The measures listed in table 14 as having merit for further study were considered for inclusion in the final array of plans. Implementable plans which reduced flood damages were compared with each other and the "no action" plan. Table 15 summarizes the components included in the final array. These plans include an environmental quality plan, national economic development plan, "nonstructural" plan,[1] and tentatively selected plan. A discussion of the rationale used in the development of each final plan and in the dropping of those components not in the final array is presented in the following paragraphs.

(1) As required and discussed in ER 1165-2-122, Use of Nonstructural Measures in Planning for Flood Damage Reduction, and ER 1105-2-353, Evaluation of Nonstructural Measures.

Table 15 - Summary of the components in the final array of plans

Plan component	Plan[1]				
	No action[2]	Nonstructural	EQ[3]	NED[4]	Tentatively selected
Floodplain regulations	N	N	N	N	N
Flood warning and forecasting	F	F	F	F	F
Flood emergency measures	N	N	N	N	N
Flood insurance	F	F	F	F	F
Debris removal	N	N	-	N	N
Control of wetland drainage	-	N	N	N	N
More stringent control of drainage	-	N	N	-	-
Control of private levee construction	-	N	N	N	N
Flood proofing	-	N	N	-	N
Encourage public control/ownership of riverine lands	-	N	N	-	N
Encourage more land treatment	-	N	N	-	N
Ring levees at farmsteads and residences	-	N[5]	N[5]	N[5]	N[5]
Controlled cattle grazing at Lake Ashtabula	-	-	F	-	F
Subimpoundments at Lake Ashtabula	-	-	F	-	F
Aerators at Lake Ashtabula	-	-	F	-	F
Revised management of Baldhill Dam	-	F	-	-	-
5-foot raise of Baldhill Dam	-	-	-	F	F
Levees and diversion at West Fargo/Riverside	-	F[6]	F[6]	F[6]	F[6]
Flood diversion channel - Horace to West Fargo	-	-	F	F	F
Multiple-purpose dam on Dead Colt Creek	-	-	-	-	N
Restoration of drained wetlands	-	N	N	-	N
Increasing floodwater storage capacity of existing wetlands	-	N	N	-	N
Postflood relocation at Valley City and Lisbon	-	F	-	-	-

(1) "N" indicates non-Federal interests have primary implementation responsibility; "F" indicates Federal interests have primary implementation responsibility.
(2) Represents the future condition without major Federal action.
(3) Environmental Quality Plan.
(4) National Economic Development Plan.
(5) Principal responsibility for evaluation and implementation would probably be through non-Federal interests; however, Federal participation through the Soil Conservation Service or Corps of Engineers may be possible.
(6) Includes shelterbelts at selected locations and grassed waterways in and along the diversion channel.

No Action Plan

Under the "no action" plan, the future "without project" condition presented earlier would occur. Those actions pertinent to the comparison of the no action plan with the other plans include floodplain regulations, flood warning and forecasting, flood emergency measures, flood insurance, and debris removal. Floodplain regulations would continue and future development in the floodplain would recognize the flood hazard and be built so that the 1-percent chance flood would cause little or no damage. Flood warning and forecasting would continue and probably be improved as new technology, data collection techniques, and prediction capability are developed. Flood emergency measures taken just preceding or during a flood would be the primary means of preventing damage to existing development. These measures could include constructing emergency levees, moving damageable property above flood levels, evacuating residents of flooded or floodable properties, and other short-term actions. Flood insurance would continue to be available to assist in minimizing the impact of a flood loss on an individual property owner. Debris removal from the river channels and bridge openings would be necessary before and after floods, especially in reaches where the lack of sufficient flow capacity would cause extensive flood damages. The no action plan would attempt to reduce flood damages to existing development by short-term action just before and/or during a specific flood. Future development would be essentially flood proofed or flood resistant from most floods. Continuing difficulties would be encountered in the control of drainage and private levee construction. Because drainage and private levees can worsen future floods if not accomplished properly, control of these two activities would be crucial to management of future flood problems.

Nonstructural Plan

A plan reducing flood damage using primarily "nonstructural" measures as discussed in ER 1105-2-353 and ER-1165-2-122 and building on the results of the preliminary planning was developed. Valley City and Lisbon are the two locations in the basin where relocation of structures or evacuation of residents may be an implementable measure, but only under certain conditions. [illegible] areas prone to the most frequent flooding are

generally adjacent to the river and represent a significant yet relatively small portion of the city. At Valley City, the relocation option has marginal economic feasibility; at Lisbon, it clearly lacks economic feasibility. Neither community supports moving from the floodplain, in part because the flood fight efforts for recent floods have been successful and major flood damages have been averted. In the future, however, if flood fight efforts fail and these areas receive substantial damages and if funds were available immediately after the flood to acquire the flooded properties, relocation of residents from much of the Valley City and Lisbon floodplains could be implemented. At West Fargo/Riverside, where the entire community is on flood-prone land, the relocation alternative is not viable even under the above described conditions for Valley City and Lisbon. The only alternative which can address the objective of reducing flood damages for the existing development in a manner which could be interpreted as "nonstructural" is the levees and flood diversion channel plan around West Fargo. Other features of the "nonstructural" plan listed in table 15 were included to reduce the flood damages in areas outside the three main cities. The control of private levee construction and drainage to prevent the worsening of flooding would be a key element in this plan. Use of existing and drained wetlands in the upland areas to store more floodwaters would help moderate flood peaks. Most of the components of the plan would be for non-Federal implementation.

Environmental Quality (EQ) Plan

National environmental policy mandates that important cultural and natural aspects be preserved and that a diverse environment be maintained. Designation of an EQ plan implies that the plan enhances and protects the aesthetic, cultural, and natural diversity of the environment and provides positive contributions to the EQ account. The EQ plan was developed to reduce flood damages and maintain or enhance the environmental resources of the basin, working primarily with the measures carried into the final evaluation stage. The EQ plan components are listed in table 15, with the levees and flood diversion channel at West Fargo/Riverside, the flood

diversion channel from Horace to West Fargo, and ring levees at farmsteads and residences providing the nucleus of the plan. The net environmental effects of these three alternatives are about neutral with some minor losses and some minor gains. The other components of the plan are needed either to make the plan effective or provide positive environmental contributions. Measures which add environmental credits to the plan include controlled cattle grazing, subimpoundments, and aerators at Lake Ashtabula; restoration of drained wetlands; increased storage capacity of existing wetlands; encouragement of more land treatment; encouragement of public control/ownership of riverine lands; and control of wetland drainage. Some features which could enhance the environment include planting of extensive shelterbelts along the diversion channel alignments and management of the shelterbelts and grassy areas of the channels and levees for environmental purposes. Use of the wetlands areas of the basin for floodwater storage could also enhance the environment if the operating plans for the management of these areas are developed primarily around waterfowl and wildlife values. Most of the components would be the responsibility of non-Federal interests to implement as part of the overall plan.

National Economic Development (NED) Plan

The national economic development (NED) plan primarily includes plan components that would increase net economic benefits. The key components for flood damage reduction include the levees and flood diversion channel around West Fargo/Riverside, the flood diversion channel from Horace to West Fargo, the 5-foot raise of Baldhill Dam, and ring levees at farmsteads and residences. All NED plan components are listed in table 15. All four key components provide net economic benefits. The remaining components - especially control of private levee construction, control of wetland drainage, and floodplain regulations - are essential to making the overall plan work.

Tentatively Selected Plan

The components of the tentatively selected plan were chosen recognizing the economic, environmental, and implementability aspects of the potential plans and plan components. The levee and flood diversion channel at West Fargo

Riverside plus the flood diversion channel from Horace to West Fargo resulted in as good or better economic considerations for providing flood protection for the developments from Horace through West Fargo as the Kindred Dam plan K-3 or other combinations of plan components with the levee and diversion. The environmental aspects of these two components were very good when compared to other options and there appeared to be general support with little opposition. While these two components provided good protection for the area from Horace through West Fargo, other areas upstream of Horace and downstream of West Fargo did not receive any protection. Ring levees at individual farmsteads and residences offered the most cost-effective manner to protect these developments. A raise of Baldhill Dam (not exceeding 5 feet) could produce substantial benefits at Valley City and Lisbon. When considered in conjunction with the upgrading for safety reasons, the cost allocated for flood control was exceeded by the benefits. The multiple-purpose Dead Colt Creek tributary dam and increased floodwater storage capacities of existing and drained upland area wetlands in the reach from Valley City to Kindred were added to reduce flooding from the first peak on the Sheyenne River downstream of Kindred, particularly in the reach from Kindred to Horace and from West Fargo to the mouth of the Sheyenne River. Floodplain regulations, flood warning and forecasting, control of wetland drainage, and control of private levee construction are essential for an effective plan. Flood emergency measures, flood insurance, debris removal, and flood proofing can provide additional protection when used at appropriate locations and times. The encouragement of public ownership or control of riverine lands; encouragement of more land treatment in upland areas; and controlled cattle grazing, subimpoundments, and aerators at Lake Ashtabula would all provide increases in the EQ account. The control of cattle grazing, subimpoundments, and aerators at Lake Ashtabula could also be accomplished to some extent under a revised management plan for Baldhill Dam, which would be implementable under existing operation and maintenance authorities for the project. Planting of shelterbelts and grasses in selected portions of the diversion channels would help keep the channels operational and less prone to fill with drifted snow as well as providing wildlife benefits.

PLANS AND COMPONENTS DROPPED IN THE FINAL STAGE

Plans D-1, D-2, and K-3 as presented in Stage 2 were essentially dropped in the final stages; modifications to or variations of plans D-1 and D-2 were considered in the final array. Perhaps of greatest significance was the dropping of Kindred Dam and plan K-3. The flood diversion channel from the Sheyenne River to the Wild Rice River was also dropped.

Kindred Dam/Plan K-3

The Kindred Dam as a component of plan K-3 was dropped from consideration in the final array of plans primarily for environmental and implementability considerations. Although it substantially reduced flood damage in the basin (79 percent) and was economically justified (B/C ratio of 3.5), the Kindred Dam would have required the purchase of about 25,000 acres in the Sheyenne River valley between Kindred and Anselm and the relocation of up to 70 families. This plan would have had a particularly acute regional impact, because acquisition would occur adjacent to the Sheyenne National Grasslands, which has over 70,000 acres in Federal ownership already in this area. The periodic flooding of about 3,700 acres of bottomland forests would significantly affect the environmental quality of the region. The significant adverse social and environmental impacts resulted in a general lack of regional or local support for the Kindred Dam. The estimated first cost of plan K-3 is $62 million.

Diversion to the Wild Rice River

Diversions to the Wild Rice River were considered in plans D-1 and K-3. Because the Kindred Dam was dropped from consideration, any potential combination of a diversion to the Wild Rice River with the Kindred Dam was also dropped. When considered in combination with other components such as wetlands and upstream tributary dams, a diversion could serve as a viable component only if the wetlands and tributary dams implementation were ensured. There is no firm support or commitment to implement the wetlands concept without knowing the exact tracts of lands to be involved and then only if the landowners would be willing to cooperate. Also, the only tributary dam which had any support is the Dead Colt Creek structure. Because of the high degree of uncertainty associated with its implementability and because

Table 16 - Display of pertinent data on final array of plans

Item	Plan: No action	Nonstructural	EQ	NED	Tentatively selected
Economic					
Costs					
Federal first costs[1] ($ million)	--	14.4	13.3	45.1[9]	45.3[9]
Non-Federal first costs[2] ($ million)	--	27.4	29.7	21.4[9]	31.7[9]
Total first costs ($ million)	--	41.8	43.0	66.5[9]	77.0[9]
Annual costs ($1,000)	--	3,554	3,656	4,362 (9)	5,255 (9)
Benefits (average annual)					
Flood control ($1,000)					
West Fargo	--	19,551	19,551	19,551	19,551
Valley City and Lisbon	--	405[10]	--[10]	1,550	1,550[10]
				75	75[10][11]
Agricultural	--	41[10]	71[10]	5,175	5,175[10][11]
Other	--	5,173[10]	5,145[10]	26,351	26,351[10][11]
Total flood control	--	25,170[10]	24,767[10]		
Recreation ($1,000)	--	some	some	some	some
Fish and wildlife enhancement ($1,000)	--	some	some	---	some
Total benefits ($1,000)	--	25,170	24,767	26,351	26,351
Benefit-cost ratio	--	7.1	6.8	6.0	5.0
Net benefits ($1,000)	--	21,616	21,111	21,989	21,096
Environmental					
Woodlands affected (acres)	--	5	5	250	250
Shelterbelts planted[3] (acres)	--	15	15	285	285
Wetlands affected (acres)	--	20	40	500	500
Wetlands placed under management (acres)	--	18	40-300+	500+	500-800+
Grasslands affected (acres)	--	50	90	250	250
Grasslands placed under management (acres)	--	110	255	350	350
Cropland affected (acres)	--	60	100	350	350
Average annual equivalent loss[4]	--	--	--	142	142
Mitigation lands required (acres)	--	0	0	0-450	0-450
Cultural resources affected[8]	--	No known effect	No known effect	24 sites	24 sites
Social					
Relocation (number of homes, etc.)	--	126	3	160[12]	160[12]
Lands required (acres)	--	29,300[13]	29,500[13]	4,200	33,900[13]
Flood damage reduction effectiveness[5]	--	87	85	91	91
Number of persons benefited[6]	--	11,269	11,900	11,750	15,750
Acres of cropland benefited[7]	--	103,000	103,000	58,500	115,000
Residual flood damages	29,020	3,850	4,253	2,669	2,669

(1) Implementation by the St. Paul District Corps of Engineers based on traditional cost sharing. The actual cost sharing between Federal and non-Federal interests is subject to significant change.
(2) Includes potential costs of other Federal agencies, as well as non-Federal entities (also based on traditional cost sharing).
(3) Also includes woodlands placed under management.
(4) As measured before mitigation measures are incorporated.
(5) Effectiveness is represented as a percent of total Shevenne River flood damages reduced.
(6) Estimated number of persons receiving benefits from flood damage reduction measures.
(7) Estimated cropland acreage receiving benefits as a result of reduced frequency of flooding.
(8) Includes only those impacts for sites known to date; intensive survey and testing may identify additional sites.
(9) First costs include that portion of Baldhill Dam raise allocated to the upgrading for dam safety purposes; however, the average annual costs and non-Federal costs do not include this dam safety cost.
(10) Does not include benefits for the wetlands alternative.
(11) Does not include benefits for the Dead Colt Creek Tributary Dam alternative.
(12) Includes 152 cabins on the Lake Ashtabula shoreline.
(13) Includes 28,900 acres for the wetlands alternatives. Although the total potential acreage affected appears large, in most cases the land would have marginal value as cropland and would be purchased from willing sellers.

its relative economics were not as good as the plans which used the Horace-West Fargo diversion channel, the diversion to the Wild Rice River was not considered further.

COMPARISON OF FINAL PLANS

Pertinent information on the final plans is displayed in table 16. The information presented includes costs, benefits, and impacts for all components of the plans, both Federal and non-Federal, wherever possible. In some cases, however, some of the effects are not quantifiable. For example, in the data presented for the tentatively selected plan, the costs and impacts of the wetlands alternative are included; however, quantifiable benefits are extremely difficult to estimate and none are presented in the table even though significant benefits would accrue to the plan as a result of the wetlands alternative.

All plans are economically justifiable and all provide high degrees of flood damage reduction. The tentatively selected plan benefits the greatest number of persons and largest area. Although the relocation and land acquisition impacts seem large for the tentatively selected plan, the nature of the actual impact must be considered. Most of the relocations for the tentatively selected plan (about 95 percent) are cabins around Lake Ashtabula which are used primarily as recreational summer lakeshore dwellings and their purchase would not preclude their owners from building on another site around the lake. The new sites might be set back slightly farther from the lakeshore, but the owners would still have their view and access to the lake. Of the large acreage of lands to be acquired for the tentatively selected plan, most (about 85 percent) are associated with the wetland alternative. For the wetland part of the plan, the lands involved would generally have marginal value as cropland and would be purchased from a willing seller.

The cost-sharing data in the table is based on traditional cost-sharing policy, for water resource development projects. However, because the current cost-sharing policies have not yet been established, the distribution of costs between Federal and non-Federal interests should be considered as only a guide. Final estimates and recommendations for cost-sharing and financing arrangements could vary significantly from the information presented in this report.

DESCRIPTION OF THE TENTATIVELY SELECTED PLAN

The tentatively selected plan consists of several types of components: those which would be recommended for implementation by the Corps of Engineers; those which are essential components of the plan and must be implemented by the non-Federal sponsors; and those which are important components of the overall plan, are to be implemented by other Federal or non-Federal agencies, but are not essential to the functioning of the other plan components. The location of the plan components are shown on plate 2.

PLAN COMPONENTS FOR CORPS OF ENGINEERS IMPLEMENTATION

Three plan components would be implemented by the Corps of Engineers with the cooperation and participation of non-Federal interests: a raise of Baldhill Dam, levees and a flood diversion channel at West Fargo/Riverside, and a flood diversion channel from Horace to West Fargo.

Raise of Baldhill Dam

The raise of Baldhill Dam would be primarily for the addition of flood control storage to the project, recognizing that structural modifications to the existing project are required to comply with the provisions of the Dam Safety Assurance Act. The modifications include a 5-foot raise of the design flood pool, raise of the height of the dam by about 5 feet, change in location of the gated spillway structure, and change in the operation of the dam during floods. These changes would provide 31,400 acre-feet for storage of floodwater over the existing 39,600 acre-feet of dual-use storage now available for major floods. A total storage of 71,000 acre-feet would be available for flood control. Plate 5 presents illustrations of the modifications and summarizes pertinent information for the structure. Appendix L, Flood Damage Reduction Alternatives, provides additional discussion on considered modifications to the Baldhill Dam. Appendix B, Hydrology, and Appendix K, Geotechnical, also provide additional data on the proposed raise of Baldhill Dam. The project would be operated to maintain the pool level at elevation

1266 during summer and fall to ensure that water is available for downstream water supply needs. The pool would be drawn down as necessary during fall and winter to provide storage for floodwater during spring runoff. Drawdowns to the 1257 level would be considered when severe spring floods are predicted. The stored floodwaters would be released as quickly as possible without incurring additional damages downstream to minimize environmental damages in the flood pool area of Lake Ashtabula and to have the flood storage available for another flood as soon as possible.

Under the Dam Safety Assurance Program, major upgrading of the Baldhill Dam is required. The upgrading would result in major changes to the existing embankment and main public use area because construction of additional spillway capacity on the east abutment is needed. The 5-foot raise of Baldhill Dam and changes in the operation for flood control would require the purchase of about 3,500 acres of lands around and upstream of the lake including the relocation of many cabins and some farmsteads and some additional modifications to the embankment and gated spillway. Many of the cabins that would be affected could be relocated by the property owners to other sites around the lake. The additional flooding of project lands by the raise would require actions to mitigate for fish and wildlife losses. The mitigation measures are described in Appendix D, Environmental Resources; Appendix L, Flood Damage Reduction Alternatives; and Appendix N, Fish and Wildlife Coordination Act Report. Several aspects of the plan that would enhance the natural resources around Lake Ashtabula include control of the cattle grazing on Federal property around the lake, development of subimpoundments at the upper end of the lake, and use of aerators in the lake. Part of the modifications at the lake would be the formal recognition of recreation and fish and wildlife project purposes.

Levees and Diversion Channel at West Fargo/Riverside

The levees and diversion channel at West Fargo/Riverside consist of two segments of levees, a flood diversion channel and associated control structures, interior drainage facilities, and other features which provide a very high degree of flood protection (standard project flood) for the cities of West

Fargo and Riverside. The general features of the project are presented on plate 3. Additional information on the project is also presented in Appendix C, Hydraulic Analysis and Interior Drainage Design, and Appendix L, Flood Damage Reduction Alternatives.

The operation of the project calls for closure of the control structures at the upstream and downstream river crossing whenever river flows or stages at West Fargo reach damaging levels. Sheyenne River flows would then be diverted through the diversion channel. During low and normal flows, the Sheyenne River would flow through the natural river channel. The flood diversion channel would be sized to pass flows comparable to what the Sheyenne River would be capable of handling with some form of effective levees placed along the existing river through West Fargo. The height of the levees is planned to be 3 feet above the standard project flood level through the area. Drainage ditches and ponding areas are included to handle interior runoff; the Sheyenne River channel and the Drain 21 channel within the leveed area would serve as ponding areas. The levee on the west side of the diversion channel would be a closed loop completely encircling the development. On the east side of the diversion channel, however, the levee would tie back into high ground near Interstate Highway 94 on the southeast corner and the railroad embankment on the northeast corner. Because of the potential stability problems associated with the soils, the levees would be set back away from major excavations such as the diversion channel.

Shelterbelts would be placed along selected portions of the diversion channel to reduce erosion, reduce the amount of snow accumulating in the channel, and provide wildlife habitat diversity in a generally treeless area. The levees and diversion channel slopes and berm areas would be planted with grasses that would provide the optimum mixture for project operation, wildlife values, and compatibility with nearby developments. Features for enhancement of fish and wildlife values such as increased plantings of shelterbelts for primarily wildlife values would be considered for development at appropriate locations with concurrence and sponsorship of local interests. Similarly, limited recreational facilities in the form of trails and associated facilities would be considered. Fish and wildlife and recreation would be involved as project purposes to allow for the development of such opportunities.

Flood Diversion Channel from Horace to West Fargo

The flood diversion channel from Horace to West Fargo would consist of an excavated grass-lined channel parallel to and about 1 mile west of the Sheyenne River between Horace and West Fargo. The inlet to the channel would be located about 1 mile upstream of Horace. The downstream end of the channel would join the diversion channel around West Fargo/Riverside on the north side of Interstate Highway 94. The diversion channel would be operated to allow low and normal flows to go down the natural Sheyenne River channel. During higher flows, the water arriving at the diversion structure would be divided with flows in the diversion channel gradually increasing as the total flow increased so that when peak flows occur, such as occurred during the 1979 flood, the flows would be about split evenly. The location of the diversion channel and pertinent information on the size of the channel is presented on plate 4. The side slope of the channel would be grassed.

PLAN COMPONENTS FOR IMPLEMENTATION BY OTHERS - ESSENTIAL

Several plan components essential to the operation and effectiveness of the plan would have to be implemented by non-Federal interests. These components include floodplain regulations, control of private levee construction, and control of drainage.

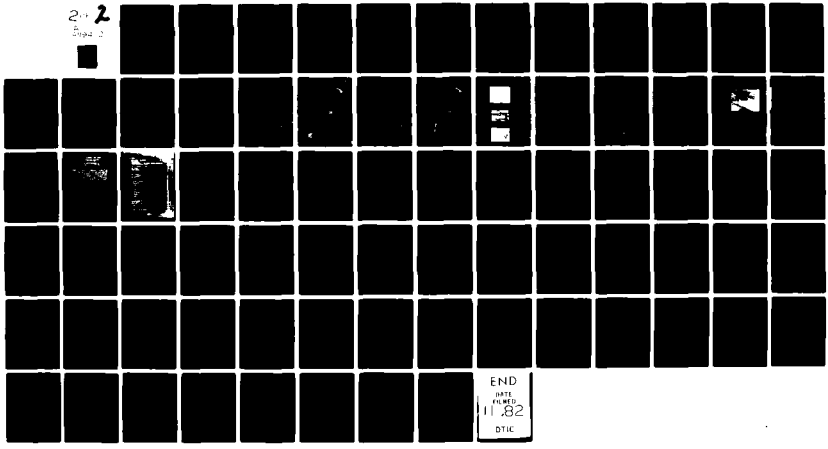
Floodplain Regulations

The adoption of floodplain regulations where they do not now exist and enforcement of existing and newly adopted floodplain regulations by the non-Federal agencies which regulate land use are essential to preserve the flood-carrying capacity of the floodplain and ensure that any development in a flood prone area does not subject the development to unwarranted flood risks. The floodway should be preserved for the passage of large floods. In the area downstream of about river mile 75 of the Sheyenne River near Kindred, regulation would include not only buildings but all road construction in about a 5-mile wide strip from near Kindred to the mouth of the Sheyenne River. Roads raised

AD-A119 482 CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT F/G 13/2
GENERAL DESIGN MEMORANDUM. PHASE I AND ENVIRONMENTAL IMPACT STA--ETC(U)
JAN 82

UNCLASSIFIED NL

2 OF 2



without providing for floodwater-carrying capacity could change the flood characteristics of the area and result in significantly worsened flood damages in some areas. Generally, the 1-percent chance flood is used as the base flood for regulation purposes; this flood should be used for all portions of the basin except the area downstream from river mile 75 where larger floods, such as the standard project flood, should also be considered. The effectiveness and integrity of the levees and diversion at West Fargo/Riverside depends on the preservation of the flood-carrying capacities of the upstream and surrounding areas for floods up to at least the standard project flood. Roads and railroads in the area should not be raised without providing for sufficient flood-passing capacity. Floodplain regulations would prevent increases in flood damages resulting from new construction outside protected areas.

Control of Private Levee Construction

Public regulation of private levee construction is necessary to ensure that flood levels are not increased upstream or downstream of the private levees. Any increase in flood levels caused by private levee construction could jeopardize the protection provided by other plan components and could worsen flood damages in some areas. Individual ring levees around a farmstead or residence which do not affect floodplain storage or flood-carrying capacities are not of concern. However, any continuous stretch of levee which parallels the river, preventing the breakout of floodwaters, and appreciably affects floodplain storage or flood-carrying capacities is of concern and should be regulated in the public interest. Levee locations and heights should be approved by the water resource districts and the State of North Dakota before levee construction could commence. The existing laws of the State of North Dakota appear to have sufficient authority to provide adequate regulation; however, criteria and rules to be used in the levee regulation need to be developed.

Control of Drainage

Public regulation of drainage is necessary to prevent increases in the frequency or severity of floods. Uncontrolled drainage can change the runoff characteristics of a watershed by reducing the time and increasing the amount of runoff. In some cases, the frequency and magnitude of floods, particularly in the moderate-sized floods, can be increased. Increases in the frequency and/or magnitude of floods resulting from uncontrolled drainage could reduce the effectiveness of the other plan components. If drainage is to occur, proper control structures should be built to ensure that the flood characteristics downstream would not be adversely affected. North Dakota laws now require permits for any drainage projects which have a watershed larger than 80 acres. This law seems to provide sufficient authority; however, the development of criteria and rules to provide effective regulation appear necessary. Control of the drainage should be considered on a basinwide watershed approach. A regulation board or panel would be helpful in providing an effective coordinated operation of future drainage projects. Drainage of any areas of the basin which are now considered "noncontributing" or contribute runoff only during very infrequent events are of particular concern.

PLAN COMPONENTS FOR IMPLEMENTATION BY OTHERS - IMPORTANT TO ACHIEVING OBJECTIVES

The remaining plan components are to be implemented by either other Federal agencies, non-Federal interests, or in some cases in part by the Corps of Engineers and are important to achieve the overall objectives of the plan. These components include flood warning and forecasting, flood emergency measures, flood insurance, multiple-purpose dam on Dead Colt Creek, ring levees at farmsteads and residences, increasing the floodwater storage capacity of existing and drained wetlands, debris removal, flood proofing, encouragement of public control/ownership of riverine lands, and encouragement of more land treatment.

Flood Emergency Measures

For damageable floodplain developments where other plan components do not reduce flood damages, flood emergency measures would prevent damages just before the actual floods. These measures would include temporary emergency levees where they would be cost effective, particularly at Valley City and

Lisbon for those infrequent floods that would exceed the capabilities of the raised Baldhill Dam in keeping flows below damageable levels. Evacuation of people and property from areas under threat of imminent flooding is a prudent measure and one for which contingency plans should always be prepared. Federal, State, and local funds should be used as appropriate, including the use of Corps of Engineers funding for construction of temporary levees when necessary.

Flood Warning and Forecasting

The flood warning and forecasting services of the National Weather Service are necessary for the proper planning and preparation for an anticipated flood from several days up to several months in advance depending on the type of flood. This advance warning is needed for efficient operation of flood control reservoirs and the timely construction or upgrading of temporary levees. Advance warning is also needed for the operation of flood diversion channels. However, flood warning and forecasting has much greater significance under the existing and "future without" project conditions than with the proposed projects in place. Continuation of flood warning and forecasting services would still be needed in the basin.

Flood Insurance

Federally-subsidized flood insurance would be important for existing developments not protected by the proposed plan. However, flood insurance for new developments should be assessed at actuarial rates.

Multiple-Purpose Dam on Dead Colt Creek

A dam and reservoir on Dead Colt Creek near the confluence of Dead Colt Creek with the Sheyenne River would serve several purposes, most noticeably flood control and recreation. The dam with a permanent lake plus additional floodwater storage would provide needed water-based recreational opportunities for residents of Lisbon and the surrounding area. The flood control storage would assist in reducing peak flood discharges for the first peak in the downstream area. When considered with the other plan components, this dam would

provide its most significant flood damage reduction effects to agricultural areas from Kindred to the mouth. The operation of the reservoir would have to consider the effects of releases on downstream areas and would have to be coordinated with releases from Baldhill Dam to ensure that peak flood discharges during the second peak on the Sheyenne River are considered in reservoir operation. This plan component is being developed by non-Federal agencies in North Dakota.

Ring Levees at Farmsteads and Residences

Ring levees at farmsteads and residences in rural floodplain areas, particularly in the reach from Kindred to Horace and from West Fargo to the mouth of the Sheyenne River, would provide protection from floods to the residents of existing dwellings outside of the protection provided by the other plan components. The concept of ring levees as discussed here would also include other flood proofing or nonstructural flood damage reduction techniques that may be more appropriate or economical for specific structures. These levees would be designed to provide protection from the base flood as defined for that reach of the river. Criteria for the design of these levees would be anticipated to be comparable to the design criteria established by the Soil Conservation Service for this type of situation. Care would have to be taken in the development of these ring levees that flood stages would not be increased by the raising of a driveway, road, levee, or other continuous feature that would restrict the flood-carrying capacity of the river. This measure is intended for existing development only, with new developments being controlled by floodplain regulations.

The U.S. Soil Conservation Service has an ongoing program for these type of ring levees which appears to be applicable to these portions of the basin. Non-Federal interests would be instrumental in implementing this component. Further evaluation of potential participation by the Corps of Engineers could also be undertaken through the feasibility study of farmstead ring levees in

the Red River of the North basin. At specific groups of residences, such as Harwood, Rivertree and Brooktree, further evaluation for Federal participation through the Corps of Engineers could be considered as part of the small projects program or under the ring levee program.

Increasing the Floodwater Storage Capacity of Existing or Drained Wetlands

When considered as a part of the overall plan, the use of existing or drained wetlands for the storage of floodwaters could reduce flood discharges for the first peak on the Sheyenne River if accomplished in sufficient numbers in the reach from Kindred to Valley City. The major flood control benefits would be to agricultural interests from Kindred to Horace and north of West Fargo. While it is unlikely that a large number of drained wetlands would be restored or existing wetlands would be modified just to provide floodwater storage, it is probable that the wetland areas would be developed for their wildlife and environmental values. When the restoration of drained wetlands or the management or preservation of existing wetlands is being accomplished for wildlife values, compatible plans to use portions of the wetland for floodwater storage could be developed. The U.S. Bureau of Reclamation is considering drained wetland areas for restoration and use as mitigation for the Garrison Diversion Unit. Any of these mitigation areas being considered in the Sheyenne River basin should include the consideration of multiple-use, with operation of the wetland areas for floodwater storage as well as fish and wildlife values.

Other agencies, such as the U.S. Fish and Wildlife Service, should consider the multiple-use concept and inclusion of floodwater storage as a purpose of their wetland acquisition and/or management. Through the multiple-purpose use of wetland areas, storage of floodwaters under this concept could become a reality.

Debris Removal

Debris removal from bridges and other channel constrictions along the Sheyenne River before, during, and after floods will help alleviate localized

flooding problems in the vicinity of the blocked constriction and could also make a difference in affecting downstream flooding by determining how, when, and where breakout flows occur. The debris removal would be accomplished by non-Federal interests, probably the Water Resource Districts.

Flood Proofing

Flood proofing would be considered in cases of existing flood prone developments where the flood proofing would be economically feasible, practical, and supported by non-Federal interests. Its use would be considered in some cases in lieu of ring levees at farmsteads and residences.

Encouragement of Public Control/Ownership of Riverine Lands

Use of public acquisition, easements, or land use controls over riverine lands could preserve many of the natural environment and floodplain values associated with the wooded strips along the rivers. For most of the Sheyenne River this type of control would be appropriate at the State or local level of government.

Encouragement of More Land Treatment

Use of more land treatment measures throughout the basin could provide water quality and erosion control benefits. Encouragement of landowners by non-Federal and Federal interests could help improve the aesthetic and environmental setting of the basin.

ASSESSMENT AND EVALUATION OF TENTATIVELY SELECTED PLAN

The tentatively selected plan represents a comprehensive approach to reducing flood damages throughout the basin when recognizing the environmental, social well-being, economic, and implementability constraints and considerations.

An assessment and evaluation of the entire plan considering all plan components would be beneficial. However, uncertainty as to degree of implementation with several of the components scheduled for non-Federal or other Federal agency responsibility requires that the primary assessment and evaluation consider only the following components:

- Raise of Baldhill Dam.
- Levees and diversion at West Fargo/Riverside.
- Flood diversion channel - Horace to West Fargo.
- Control of drainage.
- Floodplain regulations.
- Control of private levee construction.

FLOOD DAMAGE REDUCTION

The effectiveness of the plan in reducing flood damages at various locations throughout the Sheyenne River basin is presented in table 17. Flood damages in the basin would be reduced by about 78 percent. The greatest reductions occur at West Fargo/Riverside where protection is provided for the standard project flood and damages are reduced by 99 percent. Although reductions in flood damages for the 1-percent chance flood in areas outside of West Fargo/Riverside are not quantified for most areas, enforcement of floodplain regulation in these areas would reduce the growth of future flood damageable development. Implementation of the other components such as Dead Colt Creek Dam and ring levees at farmsteads and residences could further reduce damages to existing developments. The damages from the more frequent floods would be significantly reduced, and damages from the standard project flood would be less with the plan than without the plan.

ENVIRONMENTAL CONSIDERATIONS

The plan would provide net benefits to the environmental quality account. The levees and diversion at West Fargo/Riverside and the flood diversion channel from Horace to West Fargo with the grassed areas and selected areas of shelterbelts would improve the environmental quality in the area. The raise of Baldhill Dam would have some limited adverse effects because of temporary

flooding of woodlands and other habitats; however, the fish and wildlife mitigation features of the project as well as several potential enhancement features would provide net environmental benefits. Some of the more significant potential enhancement opportunities at Baldhill Dam are: (1) the creation of shallow marsh impoundments at the upper end of Lake Ashtabula with management of water levels in the marshes for fish and wildlife, (2) the controlling of grazing on project lands, and (3) the opportunity to modify slightly the regulation of lake levels and discharges to reduce the magnitude of drawdowns for flood control during the winter months in years of anticipated light to moderate runoff. The control of drainage, floodplain regulation, and control of private levee construction should result in some slight positive environmental effects from the greater consideration given to environmental values associated with drainage and floodplain development.

SOCIAL WELL-BEING CONSIDERATIONS

The plan would provide net benefits to the social well-being account. The improvements to the quality of life for over 15,000 persons greatly overshadow the adverse effects to those persons relocated or otherwise affected. Virtual elimination of flood threat to residents of West Fargo/Riverside and major reductions in the flood threat to residents of Valley City and other parts of the basin would significantly improve the physical and mental well-being of these people. About 4,200 acres of land would be dedicated to public use, and 140 cabins, 12 residences, and 5 farmsteads would have to be acquired. Most of the property acquisition is associated with the raise of Baldhill Dam. Although the numbers of persons that would be relocated and acres of land that would be acquired give the appearance of a significant social impact, most of the structures involved are lakeshore cabins. These cabins are used periodically throughout the summer and other suitable locations would be available around the lake. Much of the land around Lake Ashtabula is marginally useful as cropland because of steep slopes and low productivity. Several landowners at the upper end of Lake Ashtabula would be significantly affected by acquisition of their lands. The Uniform Relocation Assistance and Real Property Acquisition

Policies Act of 1970 would be used for all properties acquired, thus ensuring that any adverse impacts would be minimized. Incorporation of the ring levees, wetlands, and Dead Colt Creek Dam components would provide additional social well-being benefits and have some additional impacts. The net effect of these components would be beneficial.

ECONOMIC CONSIDERATIONS

The overall plan is economically justified with a benefit-cost ratio of 6.2. Individually, each of the three major components is also economically justified.

COMPLIANCE WITH EXECUTIVE ORDERS

Various executive orders and congressional acts have been used in the planning and decision-making process and in the final development of the alternatives, including the tentatively selected plan. An assessment was made of the compliance of the tentatively selected plan with Executive Order 11990, Protection of Wetlands; Executive Order 11988, Floodplain Management; Executive Memorandum, Prime and Unique Farmlands; and the Endangered Species Act of 1973, as amended.

Executive Order 11990, Protection of Wetlands, 24 May 1977

The Sheyenne River basin contains many important wetlands. In fact, most of the basin, especially the upper portion, is located in the "Prairie Pothole Region" and is considered significant waterfowl production habitat for the North American continent. Because of this fact, wetlands protection and enhancement is a planning objective and various alternatives have been formulated and evaluated to protect these values.

Various features of the tentatively selected plan would affect wetlands. The most noticeable adverse effects would result from the 5-foot raise of the flood pool of Lake Ashtabula. However, these impacts are not considered significant because the wetlands are located at the upper end of the existing permanent

pool and are expected to remain in the same general location without a drastic change in total acreage.

Various measures have been included in the selected plan to protect and enhance the wetlands of the basin. These measures include creating subimpoundments at Lake Ashtabula, restoring wetlands and on-land storage of water, and the control of future wetland drainage.

The selected plan is considered to be the most responsive to the planning objectives and would not result in unacceptable impacts on the environment or wetlands.

Executive Order 11988, Floodplain Management, 24 May 1977

This executive order requires Federal agencies to recognize the significant values of floodplains and consider the public benefits that would be realized from restoring and preserving floodplains. The principal purpose of this study was to evaluate various methods of reducing flood damages, and, since the conclusions and recommendations of this study do affect and propose changes in floodplain uses, the significant values of the floodplain must be recognized. The selected plan does propose actions which are located in and do affect the uses of the floodplain. The actions proposed for non-Federal or other Federal agency implementation are as important in their effects as the three actions proposed for implementation by the Corps of Engineers. Table 18 presents the summary assessment of the proposed plan components considering Executive Order 11988. The components would provide both potential beneficial and adverse effects on the natural and beneficial values of the floodplain. Wherever possible, actions have been taken to preserve or improve floodplain values and minimize any potential adverse effects. The residual adverse effects would be relatively minor. The net effect of the plan would be beneficial because the plan would reduce flood damages in the basin, recognizing the flood hazards of the basin, and would provide information on ways to preserve the natural and beneficial values of the floodplain. The proposed plan of action represents the most

Table 17 - Effectiveness of tentatively selected plan in reducing flood damages[1,(2)]

Damage location	Average annual conditions: Damages without plan	Average annual conditions: Benefits with plan	Average annual conditions: Percent damages reduced	5-percent chance flood: Damages without plan	5-percent chance flood: Benefits with plan	5-percent chance flood: Percent damages reduced	1-percent chance flood: Damages without plan	1-percent chance flood: Benefits with plan	1-percent chance flood: Percent damages reduced	Standard project flood: Damages without plan	Standard project flood: Benefits with plan	Standard project flood: Percent damages reduced	Magnitude of flood for which emergency measures would be needed to supplement plan (3)
Urban													
Valley City	$1,943,600	$1,430,000	73.6	6,700,000	6,700,000	100	25,900,000	1,900,000	53.7	29,000,000	0	0	3.0
Lisbon	376,700	120,000	31.9	1,627,000	188,000	11.6	4,172,000	some	--	6,884,000	0	0	11.5
Horace	492,600	439,000	89.1	1,640,000	1,640,000	100	1,888,000	some	--	1,940,000	0	0	2.0
West Fargo/Riverside	19,811,800	19,551,000	98.7	59,973,000	59,973,000	100	65,709,000	65,709,000	100	68,838,000	68,838,000	100	SPF
Harwood	475,800	--	--	1,851,000	0	0	2,712,000	0	0	3,650,000	0	0	31
Other	591,100	--	--	2,938,000	0	0	4,500,000	0	0	5,172,000	0	0	31
Subtotal	23,691,600	21,540,000	90.9	74,727,000	68,501,000	--	81,581,000	79,609,000	--	115,484,000	68,838,000	--	--
Rural residential[4]													
Kindred-Horace	1,054,500	--	--	4,589,000	--	--	5,215,000	--	--	5,789,000	--	--	26
Horace-West Fargo	1,032,200	911,000	88.3	3,911,000	3,911,000	100	4,302,000	some	--	4,407,000	0	0	2
West Fargo-Mouth	1,821,400	--	--	7,451,000	--	--	9,554,000	--	--	10,900,000	--	--	25
Other	--	--	--	--	--	--	--	--	--	--	--	--	
Subtotal	3,908,100	911,000	23.3	15,951,000	3,911,000	--	19,071,000	--	--	21,096,000	--	--	--
Agricultural													
Kindred-West Fargo	181,600	30,000	16.5	522,000	182,000	35	1,533,000	0	0	2,273,000	0	0	48
West Fargo-Mouth	873,400	41,000	4.7	3,642,000	139,000	4.6	4,833,000	166,000	3.4	5,010,000	179,000	3.6	61
Other	88,400	4,000	4.5	330,000	23,000	6.8	553,000	0	0	772,000	0	0	52
Subtotal	1,143,400	75,000	6.5	4,494,000	344,000	--	6,919,000	166,000	--	8,055,000	179,000	--	--
Transportation	196,100	35,000	17.9	975,000	359,000	36.8	1,435,000	9,000	0.6	1,538,000	9,000	0.6	--
Total	28,939,200	22,561,000	78.0	96,147,000	73,115,000	76.0	104,006,000	79,784,000	76.7	146,173,000	69,026,000	47.2	--

(1) October 1981 prices, 7 5/8-percent interest. Indexes are the same as those shown in table G-25.

(2) Based only on flood damage reductions provided by the raise of Baldhill Dam, levees and diversion at West Fargo/Riverside, and flood diversion from Horace to West Fargo. Benefits and effectiveness of other components are not included in this table.

(3) Expressed in percent chance frequency of occurrence.

(4) Includes only those areas labeled "nonurban".

Table 18 - Summary assessment of components considering Executive Order 11988

Item	Corps of Engineers implementation			Non-Federal or other Federal implementation						
	Raise of Baldhill Dam	Levees and diversion at West Fargo	Diversion channel Horace to West Fargo	Control drainage	Control private levee construction	Floodplain regulations	Ring levees at residences and farmsteads	Dam on Dead Colt Creek	Increase flood-water storage on wetlands	Overall plan
1. Is project or action located in floodplain?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
2. Reason for location in floodplain	To reduce flood damages in Valley City, Lisbon, and other areas downstream	To reduce flood damages in West Fargo and Riverside	To reduce flood damages in Horace and area between Horace and West Fargo	--	To prevent future increases in flood damages in reach from Kindred to Red River of the North.	To prevent future increases in flood damages.	To reduce flood damages at residences and farmsteads in rural areas.	To reduce flood damages at downstream locations and provide water-based recreation.	--	To reduce flood damages in basin
3. Does this action conform to State or local floodplain protection standards?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Does this action affect the natural and beneficial values of the floodplain?	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes
-Directly (1)	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
-Indirectly (2)	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
-Beneficially	No	Yes	No	No	Yes	Yes	No	No	No	Yes
-Adversely	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
-Significant adverse magnitude	No	No	No	No	No	No	No	No	No	No
5. Were steps taken to minimize potential harm to or within the floodplain?	Yes, but limited	Yes	Yes	--	--	--	No specific steps	--	--	Yes
6. Were other viable alternatives to this action considered?	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

(1) Effects which are caused by the construction, operation, or implementation of the action at the site of implementation.
(2) Effects which are caused downstream or away from the actual site of implementation, such as the area protected by a levee or the area downstream of a dam.

practical alternative plan for management of the Sheyenne River floodplain and would comply with Executive Order 11988. Additional discussion considering Executive Order 11988 is contained in Appendix M, Plan Formulation.

Executive Memorandum, Analysis of Impacts on Prime and Unique Farmlands in EIS, CEQ Memorandum, 30 August 1976

Much of the basin, including the floodplain, upland areas, and the Red River Valley downstream of Kindred, is classified as prime farmland. (See plates D-6 through D-9 in Appendix D for their location.) The diversion structures would be constructed in areas designated as prime farmland. Secondary impacts would result from increased development because of reduced flooding. The commitment of prime farmland to the construction of flood damage reduction structures is considered an acceptable tradeoff and use of the resource.

Public Law 96-159, Endangered Species Act of 1973, as Amended

In accordance with the Endangered Species Act, as amended, coordination with the U.S. Fish and Wildlife Service was conducted to determine the presence of any species included on the Federal list of endangered or threatened species in the study area and any impacts the proposed plan could have on endangered or threatened species. The peregrine falcon and the bald eagle were the species found on the lists. The tentatively selected plan components should have no adverse effects on the continued existence or critical habitat of either species.

COST ESTIMATES

The estimated costs presented here for the tentatively selected plan are for those components designated for implementation by the Corps of Engineers with the assistance and cooperation of non-Federal sponsors. These components include the 5-foot raise of Baldhill Dam, the levees and flood diversion channel at West Fargo/Riverside, and the flood diversion channel from Horace to West Fargo. The estimated construction costs for these components are presented in table 19. The total first cost of these components is $57,300,000 and the total average annual cost is $3,649,800.

Table 19—Summary of costs for tentatively selected plan

Component	First costs			Average annual costs
	Federal[1]	Non-Federal[1]	Total	
Raise of Baldhill Dam				
Dam safety	$15,200,000	—	$15,200,000	—
Flood control	16,800,000	—	16,800,000	$1,428,400
Subtotal	32,000,000	—	32,000,000	1,428,400[2]
Levees and diversion at West Fargo	9,100,000	$8,100,000	$17,200,000	$1,507,700
Flood diversion channel Horace to West Fargo	$3,975,000	$4,125,000	$ 8,100,000	$ 713,000
Total	$45,075,000	$12,225,000	$57,300,000	$3,649,800

(1) Allocation of costs to Federal and non-Federal interests were based on traditional cost-sharing policies.

(2) Includes annualized costs for the first costs allocated to flood control only.

COST SHARING

The cost sharing between Federal and non-Federal interests for the tentatively selected plan components for the raise of Baldhill Dam, the levees and diversions at West Fargo/Riverside, and the flood diversion channel cannot be determined at this time.

Table 19 presents a cost-sharing distribution based on traditional cost-sharing policies. These policies state that for major reservoir projects where the benefits are widespread the costs allocated to flood control are a Federal responsibility and that for local protection projects such as levees and flood diversion channels the non-Federal sponsors are responsible for all lands; easements; rights-of-way; and all alterations and relocations to utilities, streets, bridges, buildings, storm drains, and other structures and improvements. Changes to railroad bridges and approaches are a full Federal expense. The non-Federal sponsors are also required to operate and maintain the local protection projects after completion. Using the traditional cost-sharing formulas, the non-Federal share of the first cost would be about

$12,225,000 at the current estimate of project cost. The operation and maintenance costs of the levee and diversion projects are estimated at $45,000 annually for the levees and diversion channel at West Fargo/Riverside and $25,000 annually for the flood diversion channel from Horace to West Fargo. There are no recommendations contained in this report as to the amount of non-Federal cost sharing. The cost-sharing policies will be established by the U.S. Congress and the Administration.

LOCAL COOPERATION REQUIREMENTS

For the proposed components to serve their intended purposes, local interests must agree to certain conditions of local cooperation. Before construction, local interests would have to furnish assurances satisfactory to the Secretary of the Army that they will:

a. Pay a share of the construction cost of the project which is determined to be satisfactory to the President and Congress.

b. Prescribe and enforce regulations to prevent obstructions or encroachments on channels, floodplain and floodway areas, and ponding areas that would reduce their flood-carrying capacity or hinder the operation and maintenance of the projects and/or compromise the level of protection provided by the projects.

c. Regulate levee construction along the Sheyenne River to ensure that construction of levees would not significantly affect flood levels and/or potentially increase flood damages either upstream or downstream to the full extent permitted by existing statutes, ordinances, regulations, and rules.

d. At least annually inform affected interests of the limitations of the protection afforded by the project.

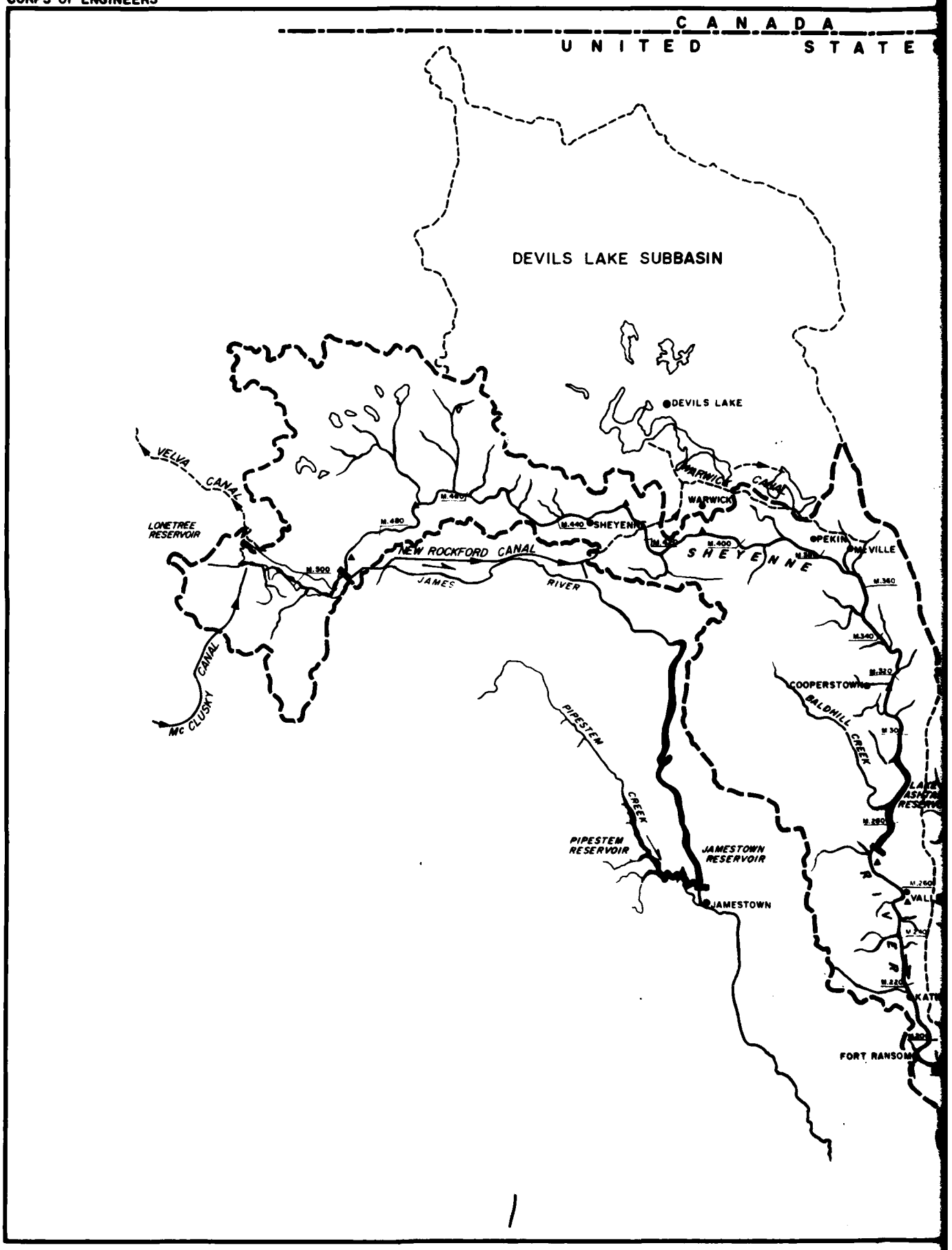
e. Maintain and operate the flood diversion channel and levee portions of the project after completion in accordance with regulations prescribed by the Secretary of the Army.

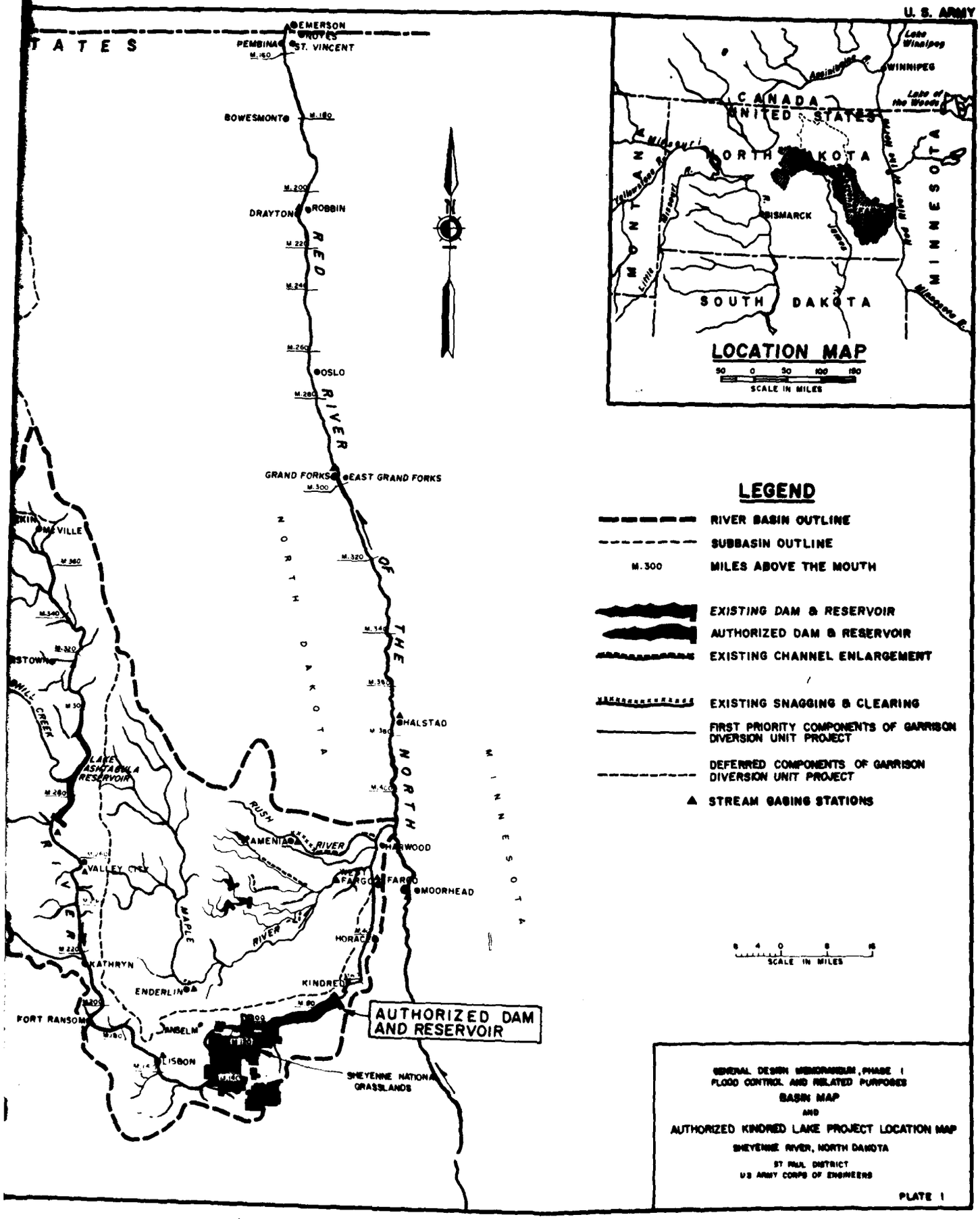
f. Regulate drainage activities in the watershed to ensure that flood frequencies and discharges are not increased or that the effectiveness of the projects is not adversely affected.

g. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to ensure compatibility between future development and protection levels provided by the projects.

h. Hold and save the United States free from damages that may result from construction and maintenance of the project, not including damages which are caused by the fault or negligence of the United States or its contractors.

CORPS OF ENGINEERS

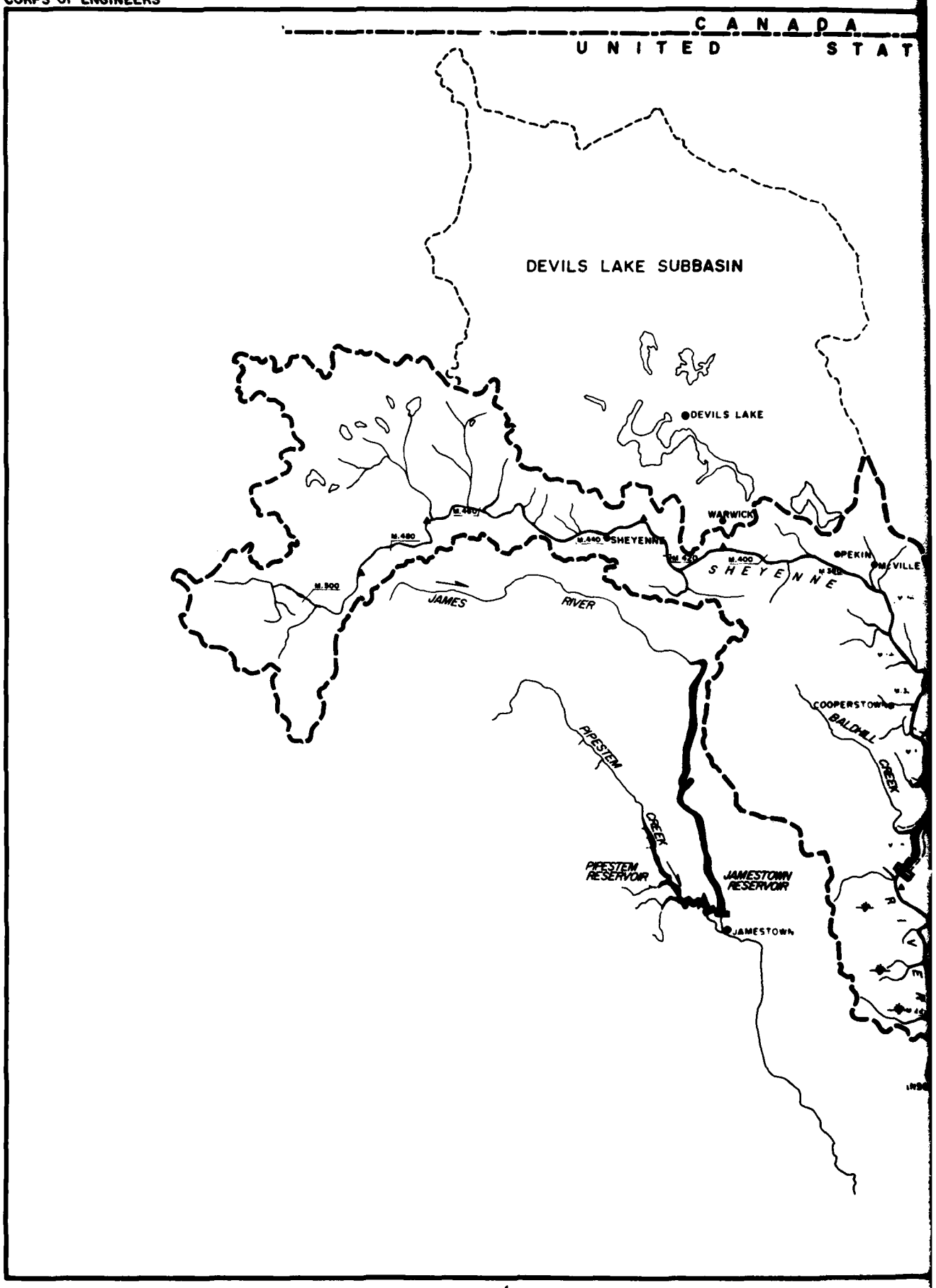




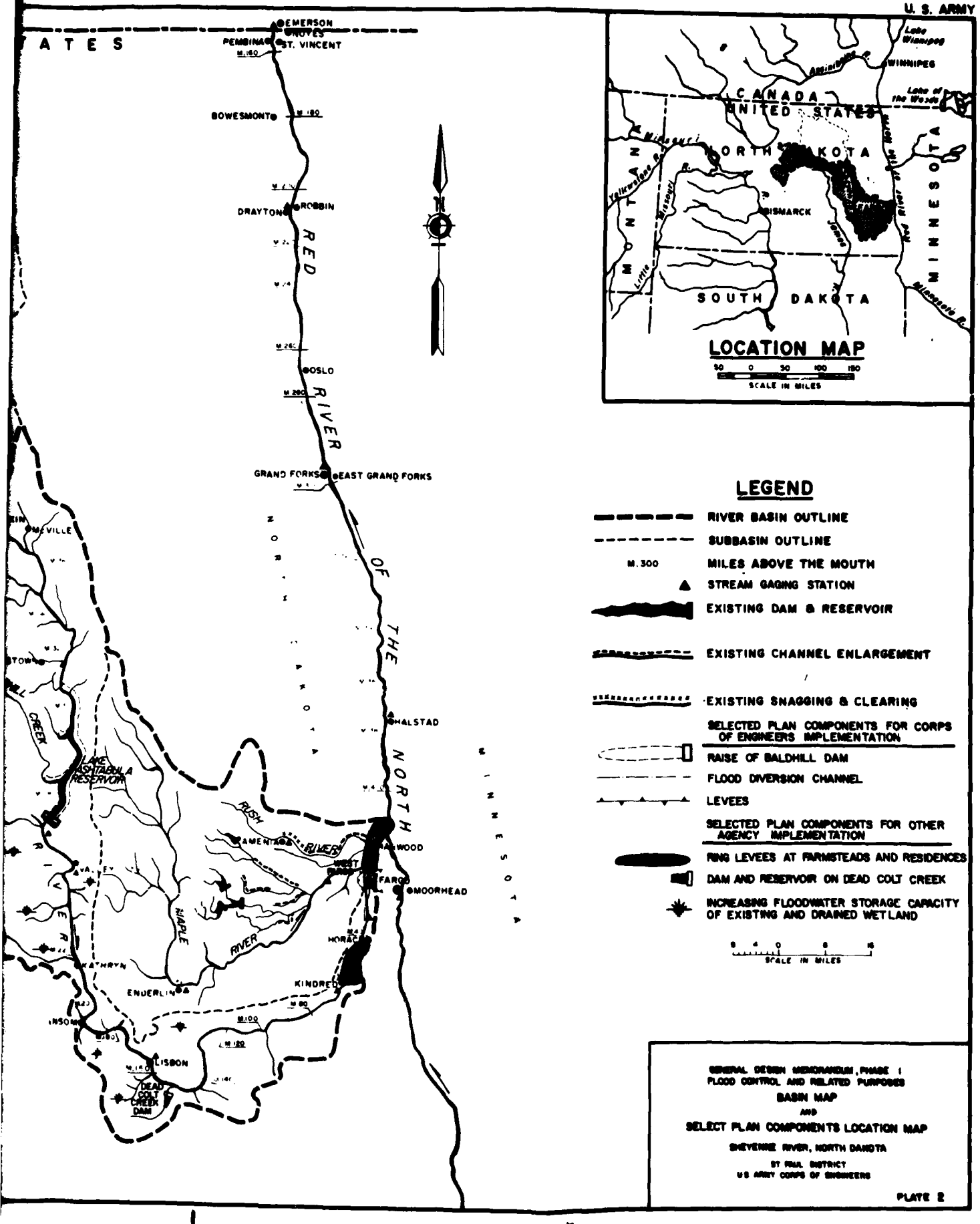
GENERAL DESIGN MEMORANDUM, PHASE I
FLOOD CONTROL AND RELATED PURPOSES
BASIN MAP
AND
AUTHORIZED KINDRED LAKE PROJECT LOCATION MAP
SHEYENNE RIVER, NORTH DAKOTA
ST PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 1

CORPS OF ENGINEERS



U. S. ARMY



GENERAL DESIGN MEMORANDUM, PHASE I
FLOOD CONTROL AND RELATED PURPOSES

BASIN MAP

AND

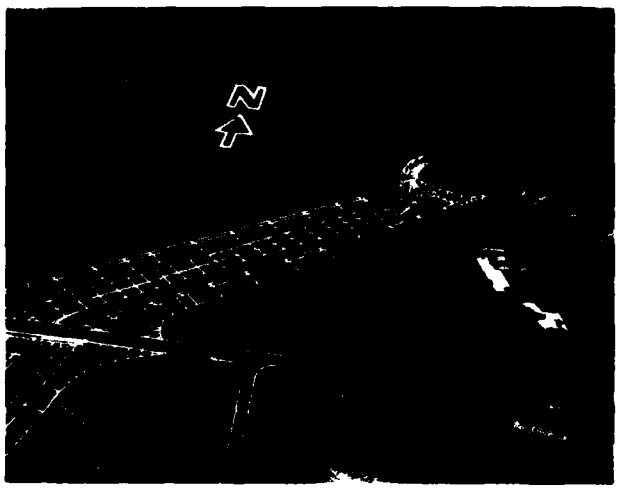
SELECT PLAN COMPONENTS LOCATION MAP

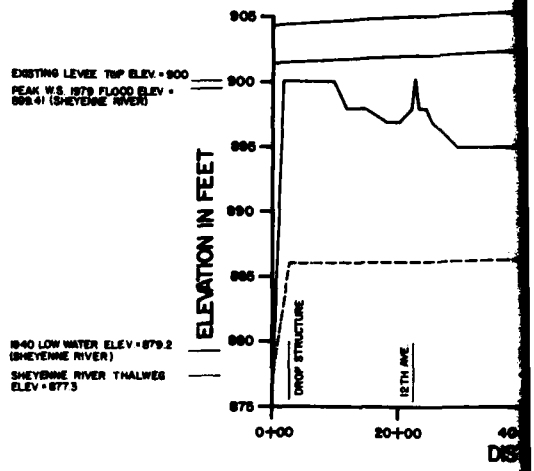
SHEYENNE RIVER, NORTH DAKOTA

ST PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

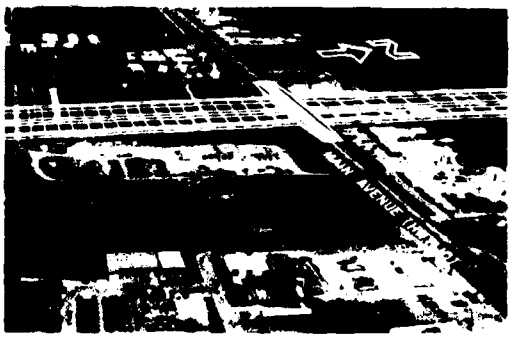
PLATE 2

OUTLET TO DIVERSION CHANNEL



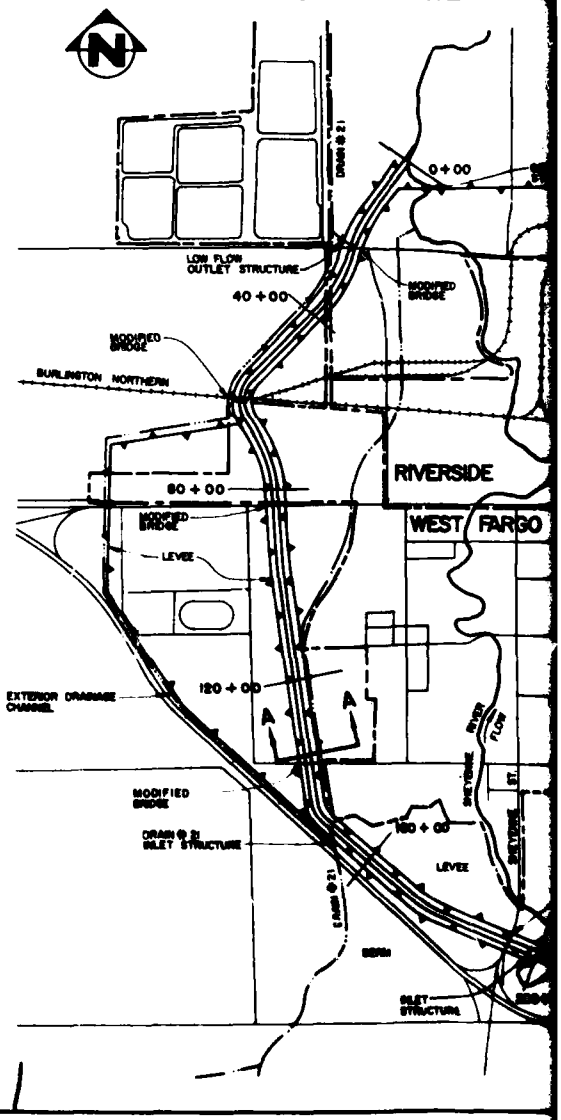


DIVERSION CHANNEL AT MAIN AVENUE

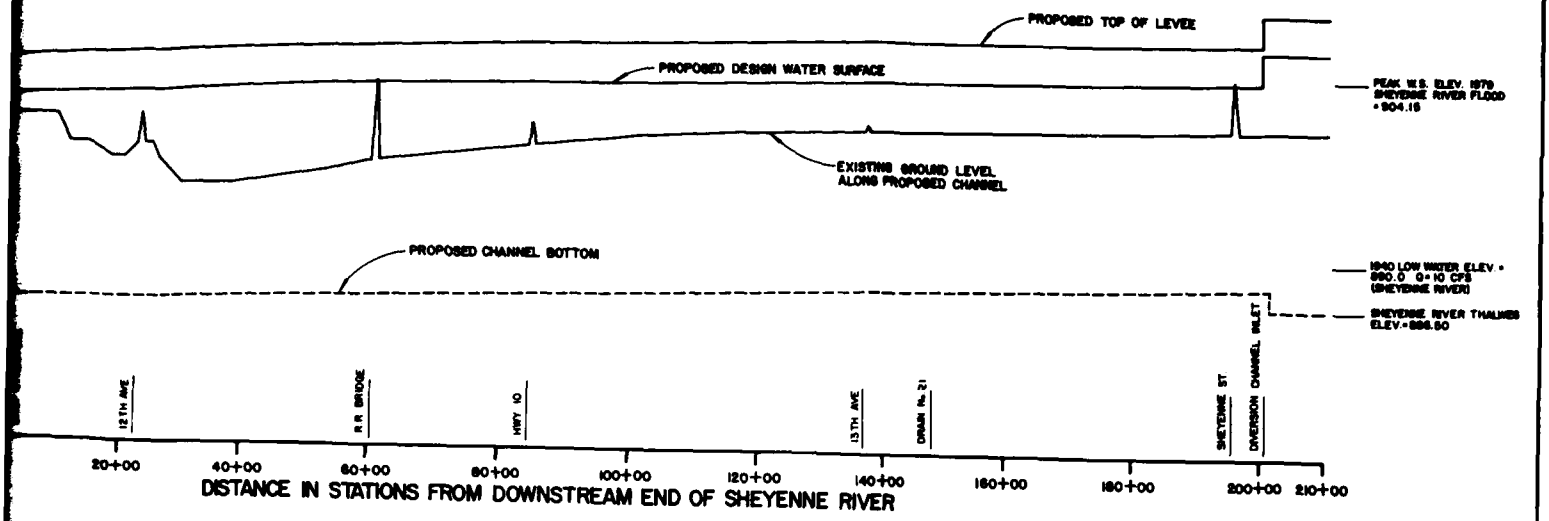


INLET OF DIVERSION CHANNEL

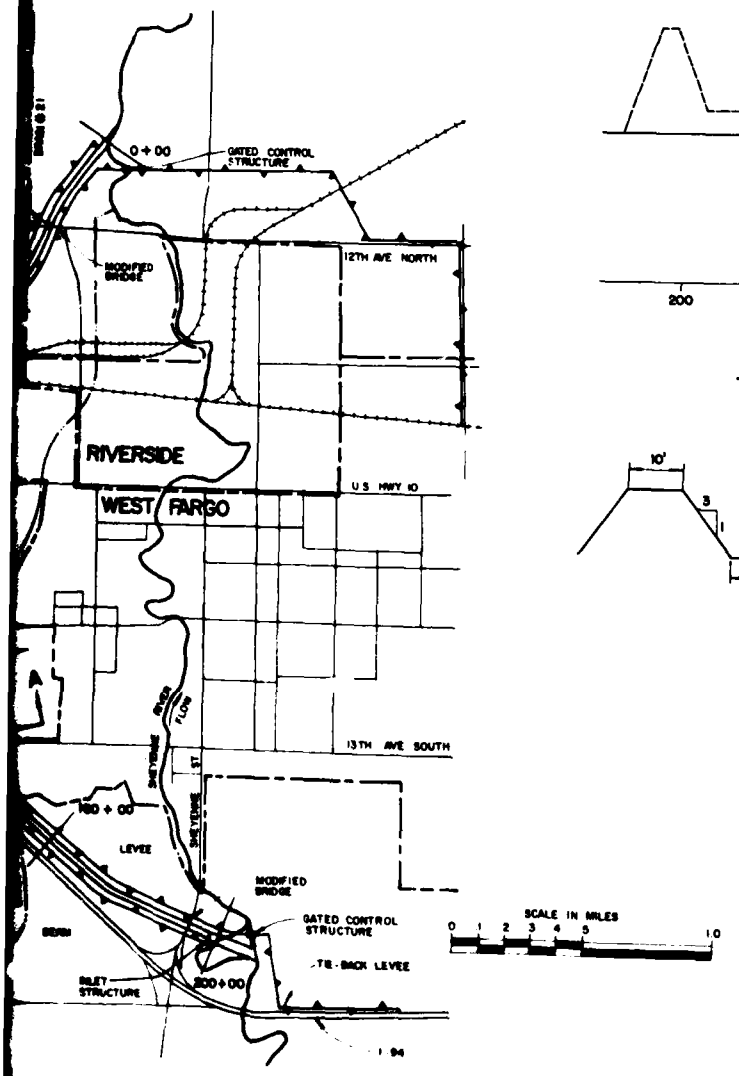
PLAN VIEW OF SHEYENNE DIVERSION AT WEST FA



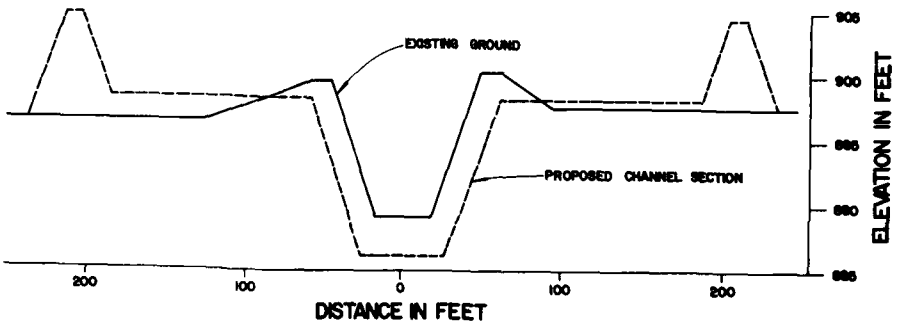
PROFILE OF SHEYENNE RIVER DIVERSION AT WEST FARGO



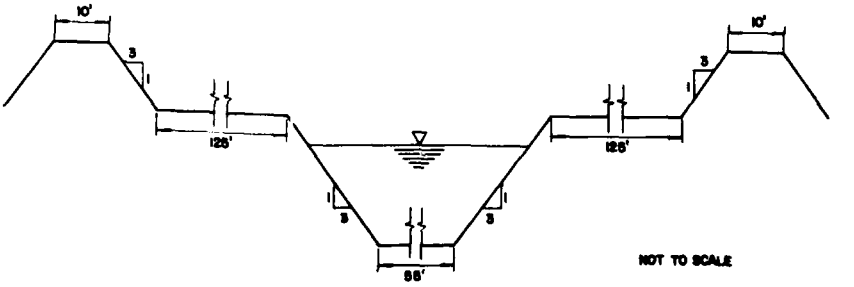
OF SHEYENNE RIVER
ON AT WEST FARGO



SECTION A-A
100' DOWNSTREAM OF 13th AVE. S.



TYPICAL SECTION OF SHEYENNE RIVER DIVERSION AT WEST FARGO



GENERAL DESIGN MEMORANDUM-PHASE I
SHEYENNE RIVER, NORTH DAKOTA

LEVEES AND FLOOD DIVERSION SYSTEM AROUND W. FARGO/RIVERSIDE (M-29 TO M-24)

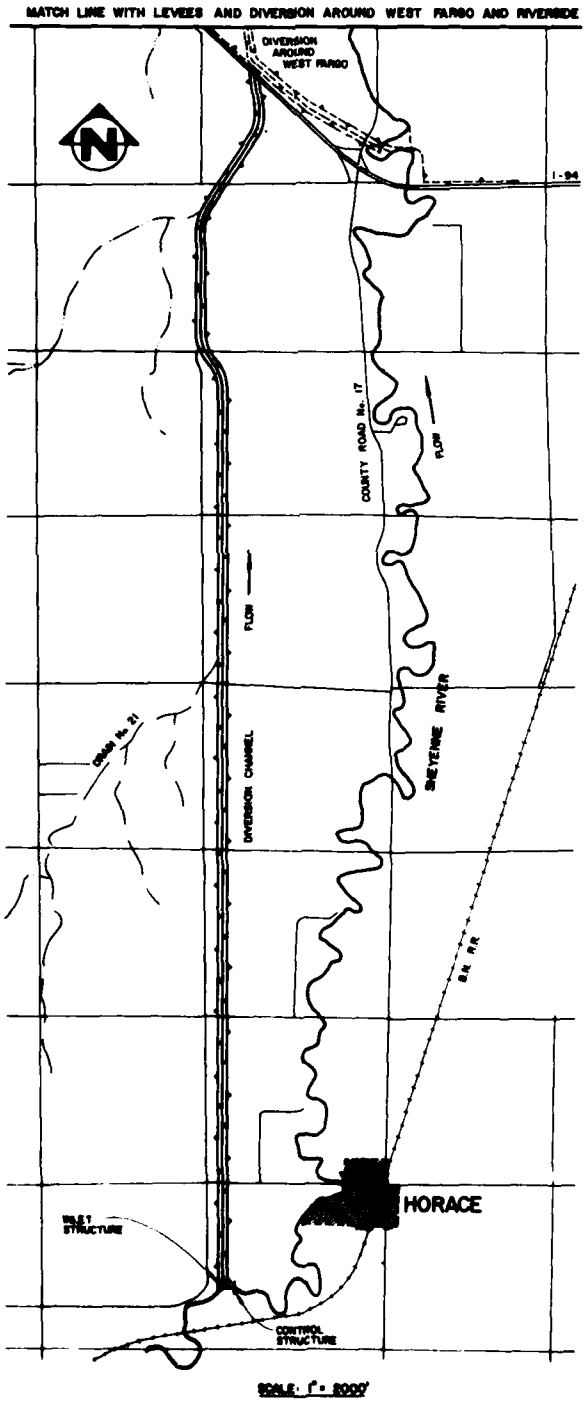
US. ARMY CORPS OF ENGINEERS

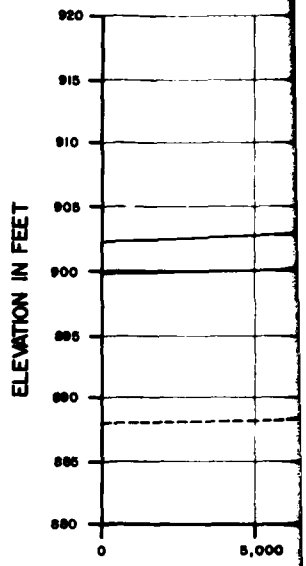
ST. PAUL DISTRICT

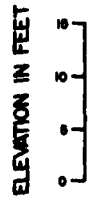
JANUARY 1982

PLATE-3

PLAN VIEW OF DIVERSION OF THE SHEYENNE RIVER
(HORACE TO WEST FARGO)

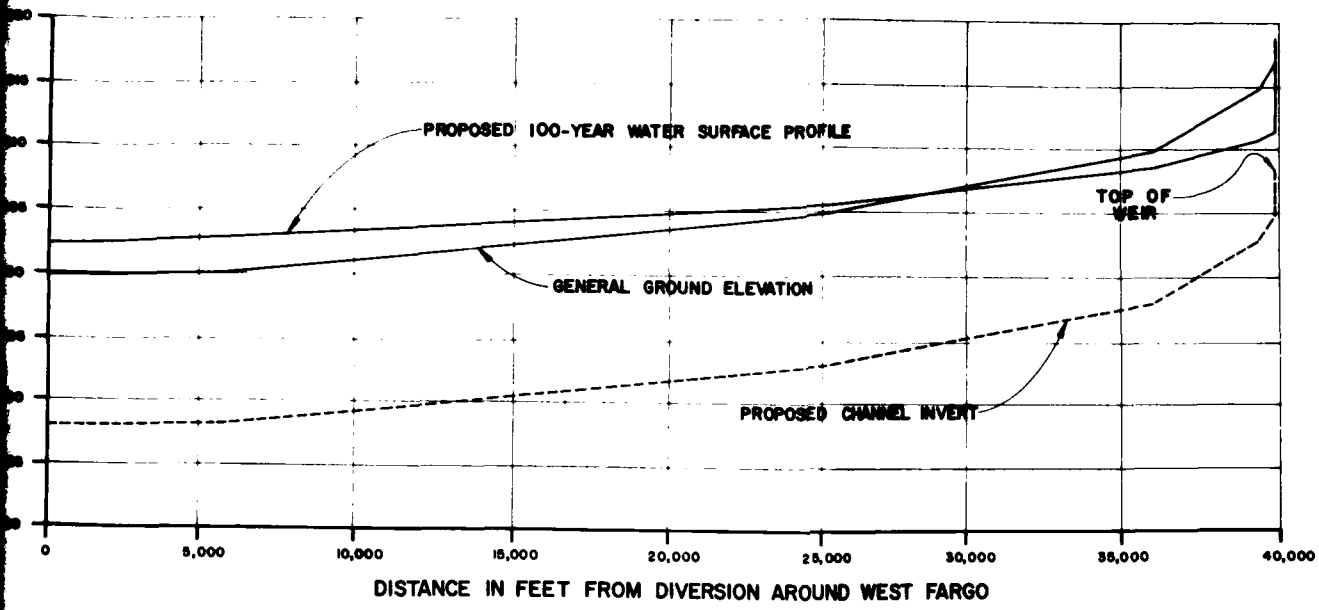




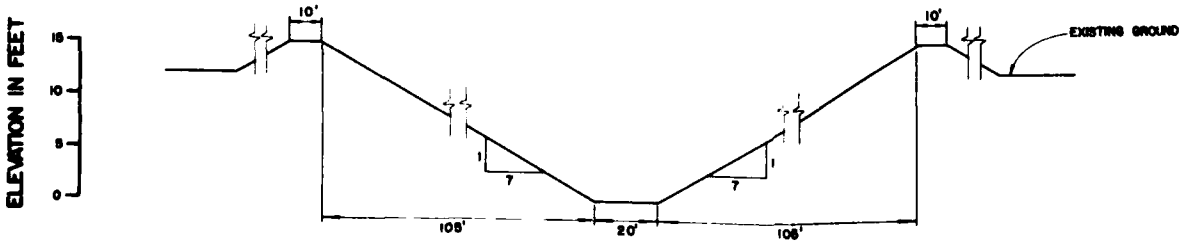


☆ U.S.GPO:1982-364-052/1089-6

PROFILE OF SHEYENNE RIVER DIVERSION HORACE TO WEST FARGO



TYPICAL SECTION OF SHEYENNE RIVER DIVERSION HORACE TO WEST FARGO



GENERAL DESIGN MEMORANDUM-PHASE I
SHEYENNE RIVER, NORTH DAKOTA

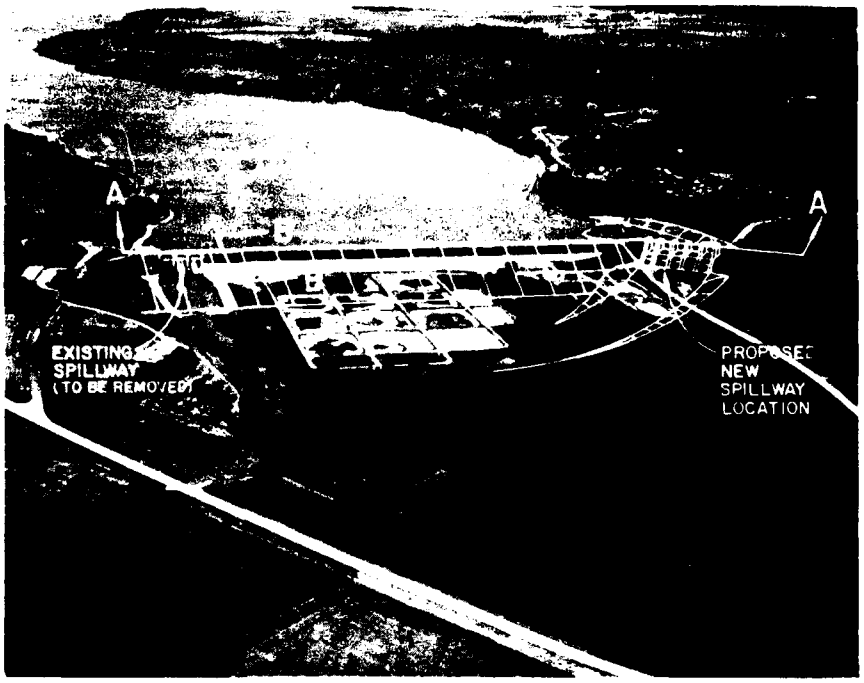
DIVERSION OF THE SHEYENNE RIVER
(M-42 TO M-44)

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT

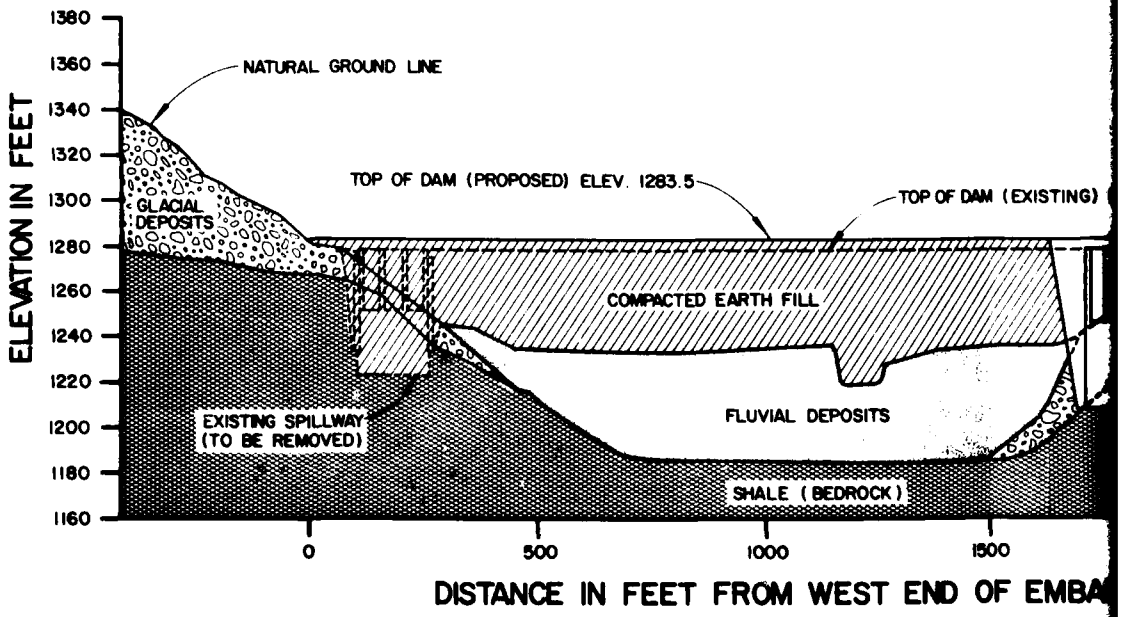
PLATE-4

JANUARY 1982

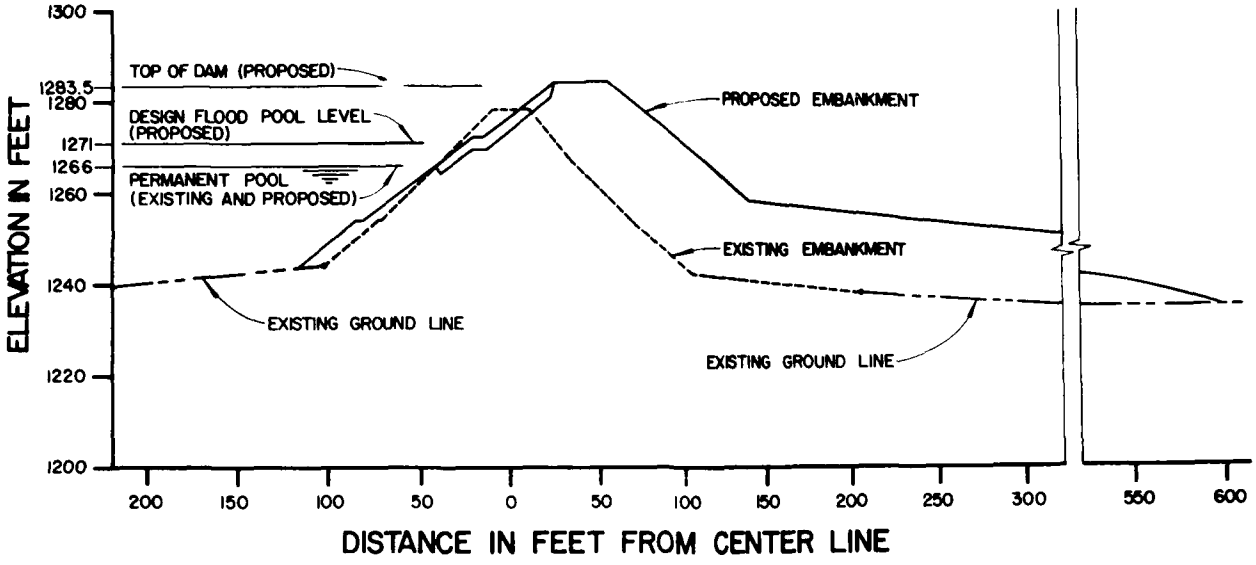
AERIAL OBLIQUE VIEW



SECTION A-A VALLEY / DAM SECTION



SECTION B-B EMBANKMENT CROSS-SECTION

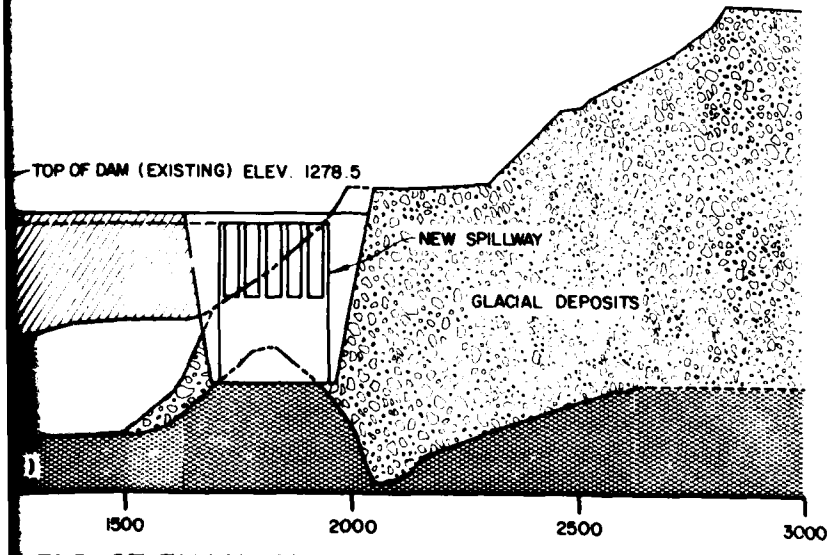


PERTINENT INFORMATION

	EXISTING STRUCTURE	PROPOSED STRUCTURE
ELEVATIONS		
TOP OF DAM	1278.5	1283.5
SPILLWAY DESIGN POOL	1273.2	1278.0
DESIGN FLOOD POOL	1266.0	1271.0
PERMANENT POOL	1266.0	1266.0
AREA (IN ACRES)		
PERMANENT POOL	5430	5430
FLOOD POOL	5430	6200
FEDERALLY OWNED LAND	8483	11390
STORAGE (IN ACRE-FEET)		
WATER SUPPLY	67800	68300
FLOOD CONTROL *	39600*	71000*
TOTAL	68600	100000

* INCLUDES 39,600 ACRE-FEET OF DUAL USE FLOOD CONTROL STORAGE

AM SECTION



END OF EMBANKMENT

GENERAL DESIGN MEMORANDUM-PHASE I
SHEYENNE RIVER, NORTH DAKOTA

PROPOSED RAISE OF BALDHILL DAM

US. ARMY CORPS OF ENGINEERS

ST. PAUL DISTRICT

JANUARY 1982

PLATE-5

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

FOR

PHASE I GENERAL DESIGN MEMORANDUM
SHEYENNE RIVER, NORTH DAKOTA

JANUARY 1982

The responsible lead agency is the U.S. Army [illegible]

Abstract: The St. Paul District is [illegible] control and related purposes on the [illegible] of the flooding occurs in an area between the [illegible] and Kindred, North Dakota, and receives [illegible] rains. Initially, 102 flood damage reduction [illegible] of these, 5 were studied in detail: the no action plan, [illegible] plan, the National Economic Development plan, the [illegible] plan, and the selected plan. The selected plan is [illegible] basis of its responsiveness to evaluation criteria and its [illegible] of planning objectives. The implementation of this plan [illegible] significant flood damage reduction, recreation, and fish and [illegible] benefits.

If you would like further information concerning this statement, please contact:

Mr. Robbin R. Blackman
U.S. Army Engineer District, St. Paul
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101
FTS Telephone: 725-7233
Commercial Telephone: (612) 725-7233

[illegible]

1.00 SUMMARY

Major Conclusions and Findings

1.01 The selected plan must satisfy specific needs of the study area and show a positive contribution to the objectives of National Economic Development (NED) and Environmental Quality (EQ). To achieve a balanced plan which reflects society's dual concern for improving national economic efficiency while maintaining and enhancing the natural environment, one plan emphasizing the Environmental Quality objective and another plan emphasizing the National Economic Development objective were developed.

1.02 The National Economic Development plan addresses the planning objectives while maximizing the net economic benefits. The 5-foot raise of Lake Ashtabula, levee and diversion around West Fargo/Riverside, and diversion from Horace to West Fargo plan maximizes net average annual benefits and constitutes part of the NED plan for the Sheyenne basin. It has a benefit/cost (B/C) ratio of 6.0 and net benefits of $21,989,000. This plan is considered implementable and has no major areas of controversy.

1.03 Environmental Quality measures are intended to preserve, enhance, or restore environmental values at a level greater than the "without" project condition. The levee and diversion at West Fargo/Riverside, diversion from Horace to West Fargo, and various EQ measures combine to form the EQ plan for the Sheyenne basin. It has a B/C ratio of 6.8. This plan is considered implementable to varying degrees. However, it does have some controversy associated with it, primarily the wetland restoration component.

1.04 The selected plan is a combination of measures that best address the problems and needs of the basin that were identified during the study process. This plan includes a levee and diversion at West Fargo/Riverside, a 5-foot raise of Lake Ashtabula, shelterbelts at selected locations along the diversion channel, control of grazing and cattle access at Lake Ashtabula, and various other measures. The plan has a B/C ratio of 5.0, and is considered implementable. (See other sections of the GDM and EIS for more detailed descriptions of the selected plan.)

1.05 The selected plan is considered to be in accordance with Executive Order 11990, Protection of Wetlands, and does not result in unacceptable impacts to wetlands. Levee locations in the selected plan have been modified to meet the requirements of Executive Order 11988 on Floodplain Management. This document contains a Section 404(b)(1) Evaluation and will be submitted to Congress with the Design Memorandum. (See the GDM and other portions of the EIS for more information on compliance with Executive Orders and statutes.)

Areas of Controversy

1.06 Acquisition of any additional lands for either flood control or required compensation at Lake Ashtabula is a controversial matter. The control of grazing and fencing at Lake Ashtabula are also controversial issues. Although landowners immediately downstream of the diversions believe that flood levels would be worsened by the project, studies have shown that flood levels would not be increased.

Unresolved Issues

1.07 Impacts on cultural resources is an unresolved issue because intensive surveys of the proposed project area have not been conducted. On the basis of previous surveys, there is a high probability that previously unknown cultural resources exist in the project area. Although cultural resource studies conducted to date are consistent with the level of detail required by ER 1105-2-50, further survey work will be necessary during the Phase II GDM to fully comply with the National Historic Preservation Act of 1966 and the Archaeological and Historic Preservation Act.

1.08 All sites located during Phase II intensive surveys that would be affected by the selected plan will be tested to determine their eligibility for the National Register of Historic Places. The results of these investigations will be coordinated with the State Historic Preservation Office and the National Park Service. In addition, comments will be requested from the Advisory Council on Historic Preservation, in accordance with 36 CFR 800, for all significant resources that will be affected by the selected plan.

Relationship to Environmental Protection Statutes and Other Environmental Requirements

1.09 Table 1 describes the relationship of the feasible alternatives that were developed in detail to applicable environmental regulations (see section 3.00 for a discussion of all the alternatives considered).

Table 1 - Relationship of Plans to Environmental Requirements and Protection Statutes
(Plan Tentatively Recommended: Selected)

Federal Statutes	No Action	Nonstructural	NED	EQ	Selected
Archeological and Historic Preservation Act, as amended, 16 USC 469, et seq.	N/A	Full	Full	Full	Full
Clean Air Act, as amended, 42 USC 7401, et seq.	Full	Full	Full	Full	Full
Clean Water Act, as amended (Federal Water Pollution Control Act), 33 USC 1251, et seq.	Full	Full	Full	Full	Full
Coastal Zone Management Act, as amended, 16 USC 1451, et seq.	N/A	N/A	N/A	N/A	N/A
Endangered Species Act, as amended, 16 USC 1531, et seq.	Full	Full	Full	Full	Full
Estuary Protection Act, 16 USC 1221, et seq.	N/A	N/A	N/A	N/A	N/A
Federal Water Protection Recreation Act, as amended, 16 USC 460-1(12), et seq.	Full	Full	Full	Full	Full
Fish and Wildlife Coordination Act, as amended, 16 USC 661, et seq.	Full	Full	Full	Full	Full
Land and Water Conservation Fund Act, as amended, 16 USC 4601-4601-11, et seq.	Full	Full	Full	Full	Full
Marine Protection, Research and Sanctuaries Act, as amended, 22 USC 1401, et seq.	N/A	N/A	N/A	N/A	N/A
National Historic Preservation Act, as amended, 16 USC 470a, et seq.	N/A	Full	Full	Full	Full
National Environmental Policy Act, as amended, 42 USC 4321, et seq.	Full	Full	Full	Full	Full
Rivers and Harbors Act, 33 USC 401, et seq.	N/A	N/A	N/A	N/A	N/A
Watershed Protection and Flood Prevention Act, as amended, 16 USC 1001, et seq.	N/A	N/A	N/A	N/A	N/A
Wild and Scenic Rivers Act, as amended, 16 USC 1271, et seq.	Full	Full	Full	Full	Full
Executive Orders, Memoranda, etc.					
Floodplain Management (E.O. 11988)	Full	Full	Full	Full	Full
Protection of Wetlands (E.O. 11990)	Full	Full	Full	Full	Full
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	N/A	N/A	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 30 Aug 76)	Full	Full	Full	Full	Full
Land Use Plans					
Sheyenne National Grasslands Land Use Plan	Full	Full	Full	Full	Full
West Fargo Development Plan	Full	Full	Full	Full	Full
State and Local Policies	Full	Full	Full	Full	Full
Required Federal Entitlements					
Water Pollution Control Act Section 404(b)(1) Permit	Full	Full	Full	Full	Full

NOTES: The compliance categories used in this table were assigned on the basis of the following definitions:

a. Full compliance - All requirements of the regulation have been met for current stage of planning.
b. Partial compliance - Some requirements of the regulation have not been met for current stage of planning.
c. Noncompliance - Violation of requirement of the statute, E.O., policy, etc.
d. Not applicable (N/A) - Regulation is not applicable.

2.00 NEED FOR AND OBJECTIVES OF ACTION

Study Authority

2.01 The Flood Control Act of 31 December 1970 (Public Law 91-611), Title II, Section 201, authorizes the Secretary of the Army, acting through the Chief of Engineers, to construct and implement the Kindred Lake project and other improvements in the Sheyenne River basin. The project is described in the report from the Chief of Engineers dated 15 September 1969, House Document No. 91-330, 91st Congress, 2d Session.

2.02 The alternatives and impacts discussed in this document were not addressed in the 14 October 1970 Final Environmental Impact Statement prepared by the St. Paul District. In 1972, a study was begun to investigate groundwater levels, water quality, and slope stability associated with the previously authorized Kindred Reservoir. In 1976, a postauthorization study was initiated to reevaluate the problems and needs of the basin and to develop alternative solutions. This GDM and EIS are the results of that study.

Public Concerns

2.03 Through public meetings, reports, and correspondence, local interests and various government agencies identified the following concerns: controlling floodplain development; urban flooding; improving water quality; and preserving wildlife habitat, aesthetic values, recreation, and cultural resources. A detailed discussion of the public involvement program is presented in the GDM, Appendix A, and in Section 5.00 of this document.

Planning Objectives

2.04 The primary planning objective is to develop an implementable plan with an acceptable level of flood protection and minimal or no environmental impacts.

2.05 The planning objectives were developed using guidance given in the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources and from identified resource management needs and public concerns. Two broad national objectives are enhancement of national economic development by increasing the value of the Nation's output of goods and services and enhancement of environmental quality by management, preservation, and restoration of natural, cultural, and recreational resources and amenities. Specific planning objectives for this project include:

a. Reducing flood damages in the Sheyenne River basin.

b. Preserving and enhancing the wildlife habitat and populations in the basin.

c. Maintaining a municipal and industrial water supply.

d. Preserving and enhancing the aesthetic and recreational amenities and resources of the basin.

e. Minimizing social impacts and relocations.

f. Preserving cultural resources.

3.00 ALTERNATIVES

3.01 Seven alternative plans were formulated during Stage 2, and were grouped according to their major element: the D plans contained a diversion; the K plans involved Kindred Reservoir. As the study progressed, modifications to the plans resulted in the Stage 3 alternatives. (See the GDM and Appendixes for more discussion of the alternatives, existing setting, and impacts.)

Plans Eliminated from Further Study

3.02 Plan D-1 - Plan D-1 would consist of a levee and diversion around West Fargo, diversion to the Wild Rice River, revised management and/or a 5-foot raise at Lake Ashtabula, tributary dams at miles 150 and 158, wetland restoration, storing water in coulees, and/or putting control structures on legal drains. Revised management of Baldhill Dam could increase fish winterkill in Lake Ashtabula, significantly affecting the recreational fishery. In addition, winter drawdowns would probably adversely affect Lake Ashtabula's use for downstream water supply and would therefore be objectionable to downstream interests. A 5-foot raise of the lake would adversely affect about 150 acres of woodland wildlife habitat. It would also require the relocation of over 100 farmsteads and residences, most of which are cabins around the lake. This plan was economically feasible. Adverse environmental impacts associated with tributary dams would probably be minor. Wetland restoration could have flood control benefits and significant wildlife value. The plan as formulated is not considered implementable.

3.03 - Plan D-2 - Plan D-2 would consist of a levee and diversion around West Fargo, diversion from Horace to West Fargo, revised management of Baldhill Dam, relocation of frequently flooded residences at Valley City, and ring levees at farmsteads and residences from Kindred to Horace and from West Fargo to the mouth. As discussed under Plan D-1, the revised management of Baldhill Dam is undesirable. The major adverse social impact of this plan would be the relocation of about 87 residences in Valley City. This plan was economically feasible; however, because of undesirable social and biological aspects, it is not considered implementable.

3.04 Plan D-3 - Plan D-3 would consist of a levee and diversion around West Fargo, a 5- to 15-foot raise of Baldhill Dam, tributary dams T-150 and T-158, restoration of drained wetlands, storing water in coulees, and/or putting control structures on legal drains from Baldhill Dam to Kindred. Raising Baldhill Dam to increase flood protection does not have overwhelming local support. In addition, adverse social impacts are significant for raises greater

than 5 feet. Over 100 residences would also be relocated under this plan. Adverse wildlife impacts would result from loss of habitat resulting from temporary inundation and would increase proportionally with the higher raises of the dam. The tributary dams have less adverse impact on fish and wildlife resources than raises of Baldhill Dam, but they do not have complete local acceptance. Wetland restoration could have significant benefits; however, local support for this measure is low. The overall plan had marginal economic feasibility.

3.05 Plan D-4 - Plan D-4 would consist of a levee and diversion around West Fargo, channelization of the Sheyenne River from Kindred to West Fargo, revised management of Baldhill Dam, tributary dams T-150 and T-158, ring levees around farmsteads, and wetland restoration. Channelization would result in significant adverse aesthetic impacts caused by the destruction of about 500 acres of woodlands, which is about 40 percent of the remaining woodlands in the area from Kindred to West Fargo. The effects of revised management of Baldhill Dam were discussed under Plan D-1. Levee alignments for ring levees around farmsteads could have minor adverse effects on wildlife and habitat because of the partial clearing of shelterbelts and windbreaks. Other impacts of this plan are similar to Plan D-3. The overall plan had marginal economic feasibility.

3.06 Plan K-1 - Plan K-1 would consist of a full-sized Kindred Dam and revised management of Baldhill Dam. The effects of revised management of Baldhill Dam were discussed under Plan D-1. The most significant adverse social and environmental impacts of all the Stage 2 plans are associated with Kindred Dam. As proposed, Kindred would be a dry dam with a 9,600-acre design flood pool (maximum flood pool would affect about 14,000 acres). About 5,000 acres of woodland would be adversely affected by the temporary storage of floodwaters, which is 19 percent of the woodlands in Richland and Ransom Counties. In addition, there are 50 rare plants and 10 rare bird species found in this area. A significant adverse social impact would be the need to relocate 57 residences, a 4-H camp, 2 churches, and 2 cemeteries. There are also 15 areas of historic significance in the pool area. This reach of the Sheyenne River has potential as a Federal or State scenic or recreational river. The dam would effectively preclude the reach from receiving this designation and could adversely affect potential for riverwide inclusion in the system. The economic justification for this alternative was borderline. The plan is not considered implementable.

3.07 Plan K-2 - Plan K-2 consists of a reduced-size Kindred Dam, a 5- to 15-foot raise of Baldhill Dam, and a diversion of the Maple River to the Red River. Although the reduced-size Kindred Dam would have fewer adverse impacts than the full-sized structure, the adverse social and environmental impacts and necessary land acquisitions would still be unacceptable. Implementation of Plan K-2 would also adversely affect potential for the Wild and Scenic River designation. The social and fish and wildlife impacts of a major raise of Baldhill Dam are considerable and have generated little support. This plan was not economically feasible. The plan is not considered implementable.

3.08 Plan K-3 - Plan K-3 would consist of a reduced-size Kindred Dam, diversion to the Wild Rice River, levees from Kindred Dam to the mouth of the diversion channel, and revised management of Baldhill Dam. The adverse social and environmental consequences of these measures and the adverse effects on Wild and Scenic River potential are significant. In addition, the major land acquisitions are considered unacceptable. The economic justification for this alternative was borderline. The plan is not considered implementable.

Without Conditions (No Action)

3.09 The following is a description of the most probable future "without project" conditions.

a. Floods will continue to occur in the basin, and their magnitude and frequency may increase if drainage continues. Low-flow periods can also be expected to continue in the basin, although there have been only 6 years with very low runoff since the 1930's.

b. In the future, increased emphasis will be placed on improvement of the relatively poor water quality in the Sheyenne basin. However, actual improvement in river and Lake Ashtabula water quality will depend on the extent of measures taken to improve the quality of runoff from agricultural and grazing lands.

c. Baldhill Dam will be evaluated under the Dam Safety Assurance Program and, pending congressional approval, will be modified to make it conform with safety requirements.

d. Construction of private levees parallel to the river in agricultural areas will probably continue. This would tend to worsen flood conditions downstream, particularly if major reaches of the river are confined. However, since the 1978 and 1979 floods, greater interest is being expressed in controlling this type of activity.

e. The clearing of woodlands and the draining of wetlands will continue and will eventually result in significant losses. Some of the woodlands being lost are valuable bottomland hardwoods. Although about an equal amount of reforestation is being done, the plantings are usually in the uplands, which are less valuable to wildlife. The rate of woodland clearing will probably decrease because much of the land suitable for agirculture has already been put to that use. Woodland losses caused by residential expansion will probably increase. A future net loss of wildlife values is likely because of wetland drainage for both agricultural and urban uses.

f. The Sheyenne National Grasslands is managed under the multiple-use concept with emphasis on grazing and erosion control. In the future, increased emphasis will be placed on wildlife, recreation, and watershed management.

g. In general, the future environmental setting, especially in the flatter, upland areas, will degrade as compared to existing conditions.

h. The population of the area will probably increase in the urban areas, while that of the rural areas will decline. The communities in the basin will continue to grow as the demand for goods and services increases. The economic resources of the basin will remain relatively stable, especially the agricultural base. Residential expansion will continue, especially outside the rural areas. (See tables F-1, F-2, and discussion of growth projections on pages F-4 to F-6.)

i. Along with increasing population and leisure time, there will be a greater need and demand for recreational development. This demand will be influenced by inflation and cost of travel.

j. The no-action conditions would not significantly affect Wild, Scenic, or Recreational River designation potential. However, debris removal from the river between Kindred and the mouth and the continued loss of woodland/wetland areas over time would degrade future designation potential. This degradation is inevitable without implementation of an active protection program by the State or Federal Government; however, no such program has been initiated.

k. Under the no-action conditions, existing impacts on cultural resources would continue to occur. These impacts include cultivation of archaeological sites and the flooding and deterioration of historic standing structures within the floodplain. In addition, if the proposed changes to Baldhill Dam occur under the Dam Safety Program, two prehistoric archaeological sites could be affected.

l. Measures used to reduce flood damages in the future will probably be similar to those currently used. Flood warning and forecasting services will continue and will become more sophisticated. Emergency flood-fighting assistance will continue as needed. After floodwaters recede, debris will be removed from the river, as is presently done. Baldhill Dam will probably not have a significant change in operation for additional flood control, mostly because of water supply concerns. Potential annual economic losses from the flooding are estimated at $27,751,500 for the lower basin (October 1980 price levels).

m. Social cohesion will continue within given communities and within given interest groups which cross geographic boundaries. Drainage, drought, floods, and levee construction will continue to cause dissension between these groups or communities.

n. Fiscal capacity of sponsors will vary with population growth and decline, national and regional economic conditions, and State and local political priorities. In general, it will remain somewhat constrained.

o. As discontinued rail service puts heavier traffic on roads, the transportation system will continue to be improved and expanded, although this will be increasingly difficult and expensive.

Plans Considered in Detail

3.10 The following plans were developed after comments were received on the Stage 2 report, and represent an optimum mix of water resource development measures.

3.11 National Economic Development Plan - The National Economic Development (NED) plan addresses the planning objectives while maximizing the net economic benefits. The NED plan would consist of a 5-foot raise of Lake Ashtabula, including modifications for dam safety; a levee and diversion at West Fargo/Riverside; a diversion from Horace to West Fargo; ring levees at farmsteads and residences; a grassed waterway in the diversion channel; shelterbelts at selected locations along the channel; floodplain regulations; control of drainage and private levee construction; flood warning and forecasting; and a flood emergency plan. Compensation would be needed for the 5-foot raise of Lake Ashtabula and would be similar to that described for the selected plan. Implementation of this plan would be a joint Federal and local effort, with total first costs of $66,500,000. The B/C ratio is 6.0.

3.12 Environmental Quality Plan - The Environmental Quality (EQ) plan maximizes net contributions to the environment and is responsive to the project's planning objectives. The major components of the EQ plan would be a levee and diversion at West Fargo/Riverside, diversion from Horace to West Fargo, ring levees at farmsteads, wetland restoration/on-land floodwater storage, control of wetland drainage, floodplain regulations, flood insurance, control of private levee construction, flood proofing, and flood warning and forecasting. Other measures that would provide net benefits to the environment include: controlling cattle grazing and access in selected areas around Lake Ashtabula; investigating the use of aerators and low-flow uses from Lake Ashtabula to improve the fishery and water quality in the lake and river; providing grassed waterways and shelterbelts for the diversion channels; creating subimpoundments at Lake Ashtabula; encouraging public ownership/easement of riverine lands through programs such as Wild, Scenic, or Recreational River designation or development of State parks, etc., for suitable reaches of the lower Sheyenne River; and encouraging the use of more land treatment measures in the Sheyenne basin, such as stock ponds, contour farming and shelterbelts. There would be no required mitigation or compensation associated with this plan. Implementation would be a joint Federal and local effort with total first costs of $43,000,000. The B/C ratio is 6.8.

3.13 Nonstructural Plan - The nonstructural plan would partially meet the study objectives through the use of nonstructural measures such as a levee and diversion at West Fargo/Riverside; postflood relocation in Valley City and Lisbon at approximately the 10-percent flood levels; flood proofing both old and new structures; ring levees around farmsteads and isolated developments; storing of floodwaters in upland low-lying areas; temporary on-land storage and permanent storage where possible; flood warning and

forecasting; flood insurance; flood emergency measures when needed; floodplain regulation; debris removal; more stringent controls on wetland drainage and levee construction; encouraging public ownership/easement of riverine lands through such programs as Wild, Scenic, or Recreational River designation or development of State parks, etc., for suitable reaches of the lower Sheyenne River; and possibly revising management of Baldhill Dam to the degree that is compatible with water supply and fishery needs. The only compensation required with this plan would be to offset some of the fishery impacts that would result from revised management of Baldhill Dam. Details for the compensation requirement, however, have not been determined. Implementation would a joint Federal and local effort, with total first costs of $41,800,000 (1981 dollars). The B/C ratio is 7.1.

3.14 Selected Plan - The selected plan would consist of a levee and diversion at West Fargo/Riverside; diversion from West Fargo to Horace; a 5-foot raise of Baldhill Dam including modifications for dam safety; a multiple-purpose reservoir at Dead Colt Creek; ring levees at farmsteads and residences from Kindred to the mouth of the river; restoration of drained wetlands and on-land storage of water; floodplain regulation; flood proofing; flood warning and forecasting; stringent control of private levee construction and wetland drainage; grassed waterway and shelterbelts along portions of the diversion; controlling grazing and cattle access at Lake Ashtabula; creating subimpoundments at Lake Ashtabula; installing aerators at Lake Ashtabula; encouraging public ownership/easement of riverine lands through such programs as Wild, Scenic, or Recreational River designation or development of State parks, etc., for suitable reaches of the lower Sheyenne River; and encouraging the use of more land treatment measures such as conservation tillage, stock ponds, and shelterbelts.

3.15 The selected plan would require compensation to offset some of the project's impacts. The Corps of Engineers would implement the two diversions, the 5-foot raise of Baldhill Dam and the fish and wildlife compensation required for these features. Other project features and any required compensation would be the responsibility of other agencies.

3.16 The modification of Baldhill Dam for safety reasons would require the replacement of fish rearing ponds and a hatchery building which are located immediately downstream of the dam. These structures will either be relocated on existing project lands or on land acquired for that purpose. This will be an equal replacement of facilities and a project responsibility.

3.17 The temporary inundation of wildlife habitat caused by the fluctuating flood pool would adversely affect the vegetation and its value for wildlife. Three equally desirable compensation alternatives have been developed for the mitigation of habitat impacts.

3.18 If project lands are not managed for fish and wildlife purposes (for example, if they are not available or not suitable), 450 acres of habitat, including 292 acres of woodland, 155 acres of grassland, and 3 acres of shrubland, would have to be purchased and managed for wildlife mitigation.

3.19 If project lands are managed for wildlife mitigation (including fencing), 272 acres of additional woodland would have to be purchased and managed for wildlife mitigation. However, if excess grassland is acquired for other project purposes, these lands could be managed (fencing, tree planting, etc.) for wildlife mitigation and the additional 272 acres of woodland would not be needed. This is only possible if excess grassland or cropland is available and all project lands, excluding those used for other purposes, are fenced and managed for fish and wildlife resources.

3.20 It may be possible to compensate for wildlife losses with a combination of the above plans. If only a portion of the project lands is available for fencing and wildlife management, up to 450 acres of additional lands would have to be purchased to mitigate losses not compensated for on project lands.

3.21 Preliminary estimates indicate that about 140 acres of woodland and 125 acres of grassland would be required for compensation of the Dead Colt Creek tributary dam. Final design of the structure and mitigation requirements for the dam would be the responsibility of other agencies. For additional discussion of mitigation requirements and costs, see other portions of the Design Memorandum and EIS, and Appendixes I (Recreation Resource Analysis) and N (Fish and Wildlife Coordination Act Report) of the Design Memorandum.

3.22 This plan would be the most responsive to the planning objectives and overall needs of the basin. Implementation would be a joint Federal and local effort, with total first costs of $80,000,000 (October 1981 price levels). The B/C ratio for the overall plan is 5.0. The recommended plan, which would be implemented by the Corps of Engineers, consists of a 5-foot raise of Baldhill Dam, a levee and diversion at West Fargo/Riverside, and a diversion from Horace to West Fargo. It has a B/C ratio of 6.2.

Comparative Impacts of Alternatives

3.23 Table 2 presents the comparative impacts of the various alternatives.

Table 2 - Comparative impacts of alternatives (selected plan is recommended)

Impact category	Base Condition	Plan[1]: Without condition (no action)	Environmental Quality plan	Nonstructural plan	Selected plan	National Economic Development plan
Woodland	The about 21,000 acres of woodland in the lower basin provide significant economic and environmental benefits.	Clearing for agricultural and residential uses would continue. Clearing in the valley bottom is not anticipated.	Some minor clearing (about 5 acres) would be done for construction. Shelterbelts would create some upland habitat. The Wild and Scenic Rivers program would preserve some woodland.	Some minor clearing might be needed for relocations. About 5 acres would be cleared for the diversion.	About 200 acres would be affected, mostly because of the raise of Baldhill Dam. Some frequently flooded woodland would be destroyed and converted to a weed-type community. The shelterbelts and Wild & Scenic Rivers program would create and preserve some woodlands.	About 200 acres would be affected, mostly because of the raise of Baldhill Dam. Some minor clearing (about 5 acres) would be required for construction of diversions. The shelterbelts would create some habitat.
Prairie chicken habitat	Approximatley 300 prairie chickens are in the Sheyenne National Grasslands. This population is the largest in the State.	Gradual increase in numbers is expected.	No effect.	No effect.	No effect.	No effect.
Sandhills	About 70,000 acres provide many aesthetic, recreational, economic, and scientific benefits.	No change expected. Grazing will probably continue to be the major use.	No effect.	No effect.	No effect.	No effect.
Unique areas	A number of unique areas have been identified.	Unless these areas are protected by law, they may be cleared for other uses.	No effect.	No effect.	No effect.	No effect.
Mirror Pools	507 acres of upland, grassland and aquatic habitat. Fish rearing potential.	No change. Major use would be wildlife habitat preservation.	No adverse effect. Wild and Scenic Rivers designation would complement the area.	Same as EQ plan.	Same as EQ plan.	No effect.
Social cohesion	The project area is composed of diverse values, attitudes, and interests.	Existing conditions would probably continue.	Two business relocations in West Fargo. Possible concerns about inequatable effects of each alternative. Some opposition to any nonreservoir alternative.	Same as EQ plan. An additional 126 relocations at Valley City and Lisbon.	Same as EQ plan. An additional 115 relocations at Lake Ashtabula (primarily cabins).	Same as EQ plan.
Financial capability of sponsors	Dependent on tax base and rather limited.	Capability will increase, but will probably remain limited.	Unknown.	Unknown.	Unknown.	Unknown.
Sheyenne National Grasslands	The 70,000-acre area is managed for grazing, wildlife, and soil and water conservation.	Grazing will continue to be a major use. Recreation and wildlife uses will increase.	Wetland restoration and Wild and Scenic Rivers designation would affect some portions. No adverse impact expected.	No significant effect. Wetland restoration could affect some areas.	No significant effect. Wetland restoration and Wild and Scenic Rivers program could affect some areas.	No effect.
Riverine environment	About 220 miles of wooded riverine environment in project area.	Future development would decrease its quality.	The Wild and Scenic Rivers program and water quality improvements would benefit the riverine environment. Wetlands may improve water quality of the river.	No effect. Wetland restoration may improve river's water quality.	About 3 miles of river would be affected by the raise of Lake Ashtabula. Various EQ measures would enhance the riverine environment.	About 3 miles of river would be affected by the raise of Lake Ashtabula.
Economics		Average annual residual flood damages of $29,020.	B/C of 6.8. Total first costs: $43,000,000. Average annual residual flood damages: $4,253.	B/C of 7.1. Total first costs: $41,800,000. Average annual residual flood damages: $3,850.	B/C of 5.0. Total first costs: $43,000,000. Average annual residual flood damages: $3,055.	B/C of 6.0. Total first costs: $66,500,000. Average annual residual flood damages: $3,056.
Cultural	265 known prehistoric sites, 125 prehistoric site leads, 58 known historic sites, 60 historic site leads.	Existing impacts would continue.	No known effect. Intensive survey and testing might locate previously unknown significant resources.	Same as EQ plan.	Raise of Baldhill Dam could affect 23 prehistoric sites; Dead Colt Creek Dam could affect 1 prehistoric site. Intensive survey and testing may locate previously unknown significant resources.	Changes to Baldhill Dam proposed under the Dam Safety Program could affect two prehistoric sites. Intensive survey and testing may locate previously unknown significant resources.
Transportation	Reasonably well-maintained and integrated transportation network.	System will continue to be improved and expanded.	5 new bridges needed, 2 frontage roads closed in West Fargo. Road flooding during operation of Horace diversion.	5 new bridges; 2 frontage roads closed in West Fargo.	Same as EQ plan. In addition, 3 bridge raises or abandonments at Lake Ashtabula.	Same as EQ plan.
Spring-fed streams	A number of spring-fed streams entering the Sheyenne River between Kindred and Anaela help improve water quality and provide fishing benefits.	No effect is anticipated.	No adverse effect. Wild and Scenic Rivers Program would enhance and preserve portions of these streams.	Same as EQ plan.	Same as EQ plan.	No effect.

Table 2 - Comparative impacts of alternatives (selected plan is recommended)

Impact category	Base condition	Plan[1]				
		Without condition (no action)	Environmental Quality plan	Nonstructural plan	Selected plan	National Economic Development plan
Aesthetic qualities	Wildlife, vegetation, water, and variety of landscapes produce outstanding aesthetic qualities. Scenic road route developed in lower basin.	Aesthetic qualities will decline slightly because of clearing of woodlands, wetland drainage, and decline of wildlife.	No significant adverse effect. Net benefits would accrue as a result of the various EQ measures.	Benefits could accrue from wetland restoration and and relocations.	Amount of dead vegetation would increase because of raise of Lake Ashtabula. Benefits would accrue from various EQ measures.	No significant adverse effects. Shelterbelts would provide some benefits. Increased amount of dead vegetation from raise of Lake Ashtabula.
Fishery in river and Lake Ashtabula	53 species of fish present. 15% of river fishing in State is on Sheyenne River. Lake Ashtabula has for fair fishery as a result of stocking program.	Water quality will continue to decline. Fishery may also decline as a result.	Subimpoundments, controlled grazing, and low-flow augmentation would enhance the fishery.	No effect.	Raise of Lake Ashtabula could eliminate some spawning habitat. Subimpoundments and controlled grazing would enhance the fishery.	Raise of Lake Ashtabula could eliminate some spawning habitat.
Federal threatened and endangered species	Bald eagles and peregrine falcons probably migrate through the area. No nesting.	No change except that caused by impacts outside of project area.	No adverse effect.	No effect.	No adverse effect.	No effect.
State rare species	33 rare plants and 7 rare birds in area. Some are restricted to the Sheyenne basin (Kindred to Anselm).	Some clearing, draining, etc., is anticipated These species may be affected because of their unique requirements.	No adverse effect. Some of the measures would preserve the habitat and therefore benefit the rare species.	No effect.	Same as EQ plan.	No adverse effect.
Wildlife	The lower basin is a prime wildlife area because of the abundance and type of vegetation present. Game and nongame birds and mammals are a significant resource.	Wildlife management practices will increase. Limited developments anticipated will cause declines in habitat and populations.	The various EQ measures would benefit the the habitat and wildlife. Habitat would be preserved or enhanced.	Wetland restoration and on-land storage would benefit wildlife.	Some habitat would be destroyed or adversely affected by the raise of Baldhill dam. Wildlife and habitat would be preserved or enhanced by various EQ measures.	Some wildlife habitat would be adversely affected by the raise of Baldhill Dam.
Wetlands	About 150,000 acres in basin--more than half are upstream of Lake Ashtabula.	Some draining expected especially on existing agricultural lands. Little draining expected at reservoir sites. Acreage and values will probably decline.	Wetland values and habitat would be enhanced through restoration. About 40 acres of ditch-bottom wetlands would be adversely affected.	Wetland restoration and on-land storage would enhance wetland values. About 20 acres of ditch-bottom wetlands would be adversely affected.	About 550 acres would be adversely affected by more frequent inundation caused by raise of Lake Ashtabula. Wetlands would be enhanced by wetland restoration and control of wetland drainage.	The raise of Baldhill Dam would adversely affect about 550 acres of wetlands in the upper end of the pool. Control of drainage would result in benefits.
Wild and Scenic River	The reach from Horace to Valley City has Wild and Scenic River potential. State or Federal protection may be exercised.	Because limited developments are expected, future inclusion in the system would be possible but does not seem in the near future. Debris removal from Kindred to the south would minimally affect Wild and Scenic River values.	Would foster Wild and Scenic River designation potential by improving water quality components and controlling private levee construction. Continued and increased public land control would encourage future protection of Wild and Scenic River values.	Would adversely affect a small segment of the river at West Fargo. Would benefit Wild and Scenic River values through improved water quality resulting from wetland restoration, etc. Public land controls would be encouraged.	Would adversely affect small portions of the river through West Fargo and Horace. Would improve water quality and encourage programs to secure public ownership of land.	Would have minimal adverse impacts on Wild and Scenic River attributes near West Fargo and Horace. Some benefits from improved water quality and control of of private levees.
Hunting	Upland game hunting predominates at Kindred area and waterfowl hunting at Lake Ashtabula. Deer hunting is significant in the Kindred area.	Hunting would probably increase because of increasing populations, higher travel costs, and lack of comparable alternative sites.	Hunting opportunities would benefit through habitat enhancement.	Hunting opportunities might be enhanced through wetland restoration.	Hunting opportunities in the Lake Ashtabula area might decrease because of habitat deterioration. Various EQ measures would enhance habitat.	Hunting opportunities in the Lake Ashtabula area might decrease because of habitat deterioration.

[1] Major measures of plans, see text for details:

Without condition (no action) - Clearing of woodlands and drainage of wetlands will continue. Emergency flood fighting will continue.

Environmental Quality plan - Levee and diversion at West Fargo/Riverside. Diversion from Horace to West Fargo. Wetland restoration. Shelterbelts and grassed waterway. Subimpoundments.

Nonstructural plan - Relocation of Valley City and Lisbon. Ring levees. Wetland restoration (on-land storage). Flood proofing. Levee and diversion at West Fargo/Riverside.

Selected plan - Levees and diversion at West Fargo/Riverside. Diversion from Horace to West Fargo. 5-foot raise of Baldhill Dam. Wetland restoration. Control of drainage and private levees. Shelterbelts. Encourage public ownership of riverine environment.

National Economic Development plan - 5-foot raise of Lake Ashtabula. Levee and diversion at West Fargo/Riverside. Diversion from Horace to West Fargo. Ring Levees. Floodplain regulation. Control private levee construction.

4.00 AFFECTED ENVIRONMENT

Environmental Conditions

4.01 The Sheyenne River basin, located in a predominantly agricultural area of eastern North Dakota, has a drainage area of 6,900 square miles and drains into the Red River of the North about 10 miles north of Fargo, North Dakota. The basin occupies an area of more than 3 million acres, over 70 percent of which is cropland.

4.02 The scarcity and importance of the basin's woodlands is demonstrated by the fact that only 1 percent of it is forested. The vegetation of the basin is very diverse and includes many plants that are rare in North Dakota, most of which are found in the woodlands between Kindred and Lisbon.

4.03 Because of its diverse and relatively abundant vegetation, the Sheyenne basin also contains many species of wildlife. The woodlands between Kindred and Lisbon are essential to continue the high productivity of certain species such as white-tailed deer and to provide habitat for many rare species of birds.

4.04 Numerous cultural resource investigations have been undertaken in the Sheyenne River basin. To date, there are 265 known prehistoric and 54 known historic sites in the basin, with an additional 125 prehistoric and 60 historic site leads. Additional surveys and testing will probably identify many more sites.

4.05 The lower Sheyenne River basin consists of parts of Cass, Richland, Ransom, and Barnes Counties. This area showed a population increase of 8.6 percent from 1950 to 1970, mostly attributable to the overwhelming 25.1-percent increase in Cass County. However, Barnes, Ransom, and Richland Counties decreased by 13.1, 20.0, and 8.9 percent, respectively. The fastest growing city in the lower basin was West Fargo, which recorded a population increase of 342 percent from 1950 to 1970.

4.06 A number of land-based recreation areas and associated facilities, including city, county, and State parks, exist throughout the Sheyenne basin. Although boating, canoeing, and camping are already popular or rapidly growing in popularity, opportunities for these activities are limited and inadequate in the lower Sheyenne River basin. Lake Ashtabula and the areas upstream of the lake and between Kindred and Lisbon offer fishing and hunting opportunities. Additional water acreage; access to existing resources; and acquisition, preservation, and development of existing resources are needed.

Significant Resources and Concerns

Environmental

4.07 Significant resources identified on the basis of public interest, law, standards, and/or technical criteria include woodlands, cultural resources, wetlands, fish and wildlife, endangered species, the Sheyenne National Grasslands, wildlife management areas, and scenic qualities. A summary of these

resources is presented in the following paragraphs. The GDM and Technical Appendixes contain more detailed information, including species lists.

4.08 Woodlands - The wooded hills and valleys of the Sheyenne basin have been identified as a significant wildlife and aesthetic resource. The 28,000 acres of woodland in the lower basin provide critical habitat for many wildlife species, including white-tailed deer and nongame birds.

4.09 Wetlands - Wetlands are scattered throughout the basin, with the majority located in the upper portion. These areas provide significant waterfowl habitat in the region and are also important to waterfowl production in other parts of North America.

4.10 Fish and Wildlife - The existing fish and wildlife and their continued production is a significant resource in the basin. Both game and nongame species have a high aesthetic value. The fishery of Lake Ashtabula and the river is considered important on a local scale.

4.11 Threatened, Endangered, and Rare Flora and Fauna - There are federally-listed threatened and endangered species, including the bald eagle and peregrine falcon, which possibly migrate through the basin but do not nest there. There are also a number of species of plants and animals, some unique to the Sheyenne basin, which are found on various lists of rare species prepared by agencies and institutions in North Dakota. Some of the bird species in the Sheyenne basin are on the National Audubon Society's "Blue List." This list alerts observers to species which have suffered recent population declines.

4.12 Sheyenne National Grasslands - The Sheyenne National Grasslands, approximately 70,000 acres in size, is administered by the U.S. Forest Service. Grazing is its primary land use; however, it does contain important wildlife habitat. For example, over 90 percent of North Dakota's rare prairie chicken population is found there. The leasing of the grasslands by local residents for grazing has been identified by public input as a matter of concern. The U.S. Forest Service has begun experimental shelterbelt planting on the grasslands, using Scotch pine trees obtained from Russia. This planting has significant research value.

4.13 Wildlife Management Area - There are a few wildlife management areas in the lower basin, mostly State administered, which provide significant wildlife and recreation value. The most important of these is probably the 500-acre Mirror Pools Game Management Area, located about 15 miles downstream of Anselm. The Baldhill Dam State Game Refuge and Baldhill State Game Management Area, 600 acres and 900 acres, respectively, are adjacent to Lake Ashtabula.

4.14 Aesthetic Qualities - The woodlands, grasslands, wetlands, wildlife, and hills and valleys in the basin combine to produce significant aesthetic qualities. A scenic road has been established in the lower basin and various public lands have foot trails in the more scenic areas. The quality of the natural riverine environment is evidenced by the fact that the river qualifies for designation as a National Wild and Scenic River.

4.15 Prairie Chicken - The prairie chicken is a very rare species in North Dakota, and over 90 percent of its population is located within the Sheyenne National Grasslands. Because the prairie chicken is rare, its populations and habitat should be preserved and enhanced where possible. There is considerable public concern and scientific interest in this species.

4.16 Sandhills Environment - The sandhills area was formed through a unique combination of climatic and geologic factors. Its ecosystem encompasses about 70,000 acres and is not found elsewhere in eastern North Dakota. Local interests have identified the combination of vegetation, wildlife, and aesthetic characteristics of this area as a significant resource.

4.17 Unique Areas - A number of areas in the Sheyenne basin have been identified as unique by the State because of vegetation, wildlife, or aesthetic characteristics. These areas constitute significant natural, scientific, and educational resources.

4.18 Spring-Fed Streams - A number of spring-fed streams enter the Sheyenne River in the delta area. These streams usually have better water quality than the Sheyenne River and are therefore important for forage, fish production, and as places of refuge.

Cultural

4.19 As of 7 July 1981, no sites listed on or eligible for inclusion on the National Register of Historic Places would be affected by any of the alternatives. However, preliminary cultural resource surveys have identified numerous sites in the Sheyenne River basin. Intensive surveys and testing will be conducted as project planning progresses. Additional information on the known cultural resources of the Sheyenne River basin is available in Appendix E of this report.

Recreation

4.20 Wild, Scenic, and Recreational Rivers Program (State and/or Federal) - The free-flowing nature of the Sheyenne River, its outstanding natural and recreational values, and its relative lack of intrusion by man qualify this river for Wild, Scenic, or Recreational River status. The Nationwide Rivers Inventory, published by the Heritage Conservation and Recreation Service (HCRS) in May 1978, listed the reaches of the Sheyenne River from Horace to Lisbon (119 miles) and from Lisbon to Valley City (88 miles) as potential candidates for inclusion in the National Wild and Scenic Rivers System (i.e., shown as a category II river). The updated Nationwide River Inventory, dated September 1980, no longer lists the Sheyenne River as one currently being considered for inclusion in the system. The inventory is dynamic, however, and the Sheyenne River could easily be relisted in future updates. North Dakota State Comprehensive Outdoor Recreation Plans have identified the Sheyenne River as a possible State Wild and Scenic or Recreational River. Potential for such designation is high.

4.21 Hunting and Fishing - Recreational hunting and fishing are an important resource in the basin. Deer, waterfowl, and upland game hunting and both river and reservoir fishing are important to the local economy and to leisure activities and are therefore a significant public concern.

4.22 Riverine Environment - The riverine environment has high scenic, recreational, wildlife, scientific, and economic value of local and regional importance and is a significant resource.

Economic

4.23 The economic aspects of the plans are both a Federal and a local concern. Local sponsors have a limited fiscal capacity and are concerned that costs be closely watched.

Social

4.24 In accordance with Section 122 of the River and Harbor Act of 1970 (Public Law 91-611) and the WRC Principles and Standards, the following social factors were considered and were determined to be not significantly affected by any of the components of the various plans studied: population mobility and density, housing, education opportunities, public facilities, public services, local/regional activity, real income distribution, employment/labor force, business/industrial activity, agricultural activity, and national defense. The effects of the alternatives on floodplain development were also studied in accordance with E.O. 11988 and are discussed in detail in other sections of this report.

4.25 Potential exists for significant impacts to the following social factors: transportation, local government finance, community cohesion, displacement of people, desirable community growth, health, land use, institutional relationships, noise, aesthetic values, man-made resources, natural resources, and air and water quality.

4.26 Noise - Noise impacts are associated with the project alternatives. However, noise has not been identified as a significant issue.

4.27 Aesthetic Values - Public interest and technical criteria developed for the study have shown aesthetic values to be a significant resource and an area of concern in the Sheyenne basin. Aesthetic features include a variety of habitat types and topographic characteristics. The areas of highest aesthetic values in the project area are between the towns of Kindred and Sheyenne. (See earlier discussion in this section.)

4.28 Social Cohesion - The project area is a region of such natural and man-made variety that social cohesion could be expected to be the exception rather than the rule. The region includes a healthily growing metropolitan area, a number of agricultural service towns, a mid-sized city that serves a tourist area, and many farms and ranches. The populations of these communities have divergent values, attitudes, and interests, particularly regarding a resource such as water, which is both a threat and a necessity. Therefore, cohesion is discussed in terms of relocations of homes and businesses, perceptions of equity, and acceptability of the project components.

4.29 Fiscal Capacity of Sponsors - Possible local sponsors of the project include the North Dakota State Water Commission; the cities of Valley City, Lisbon, and West Fargo; the Water Management Boards of Ransom, Southeast Cass, and Barnes Counties; and the Soil Conservation Districts of Griggs, Barnes, Richland, and Cass Counties. Because most of the city and county organizations rely on local taxes to finance their activities, it is important that they be able to provide vital services to their citizens without imposing heavy taxes upon them. At the State level, the State Water Commission does have extensive financial resources; however, the future will probably see an increasing emphasis on the Commission's role in statewide development efforts, and this may divert funds somewhat from flood control projects.

4.30 Transportation - Roads serving the region include Interstates 94 and 29; U.S. 10; ND 26, 32, 46, and 18; county roads; and city streets. These form a reasonably well-maintained and integrated network, linking this region to surrounding areas and connecting the cities within the region. Burlington Northern railroad tracks, including those of its major east-west route through the State, cross the Sheyenne River valley at four places. The most significant obstacle to transportation besides weather is the number of river crossings required.

4.31 Man-made Resources - Baldhill Dam and Lake Ashtabula have been identified, through public concern and technical criteria developed for the study, as a significant recreational and flood damage reduction resource. The boating and fishing use of Lake Ashtabula should therefore not be degraded. (See discussion in other portions of this section for more detail.)

4.32 Natural Resources - Natural resources are abundant throughout the basin but are mostly associated with the wooded valley, grasslands, wetlands, and the river. The natural resources of the basin have been identified as significant by law, study-specific technical criteria, and public interest. Issues of concern include the woodlands, wildlife, grasslands, and recreational use. (See discussion in other portions of this section for more detail.)

4.33 Air - Impacts on air quality may be associated with various alternatives. However, air quality has not been identified as a significant issue.

4.34 Water - Water is considered a significant resource as identified by law, study-specific technical criteria, and public interest. Water supply and water quality are important considerations for public health, fisheries, and wildlife. The areas of poor water quality in the project area include Lake Ashtabula and most of the Sheyenne River. (See Appendix H for more details.) Improvement of water quality is a goal of project planning. (See discussion in other portions of this section for more detail.)

5.00 ENVIRONMENTAL EFFECTS

Significant Impacts

5.01 This section discusses the environmental effects of each alternative on the significant issues given in the preceding section. For additional information, see the Comparative Impacts and Compliance tables in this document and the Design Memorandum. The impacts are described primarily for measures that would be implemented by the Corps of Engineers. It should be noted that not all features of the plans require implementation simultaneously. See other sections of this report for implementation responsibilities.

Environmental

5.02 Woodlands - Approximately 5 acres of woodlands would be lost as a result of the construction of the diversion channels for the NED, EQ, nonstructural, and selected plans. However, all of the plans would mitigate this loss through measures such as shelterbelt planting along the diversion channel. The EQ and selected plans could enhance and preserve woodland habitat and wildlife populations through programs such as land treatment measures and the Wild and Scenic Rivers Program. The NED and selected plans would affect another 200 acres because of the raise of Lake Ashtabula and the subsequent inundation of woodlands. This would destroy some woodland vegetation and create areas of more weedy vegetation. If Lake Ashtabula project lands are fenced, compensation in the amount of 272 acres of managed woodlands would be required with the selected plan. If Lake Ashtabula project lands are not fenced to control grazing, 450 acres of woodland, grassland, and shrubland would be needed for compensation. (See Alternatives Considered in Detail for more discussion of compensation plans.) These woodlands provide habitat for the abundant basin wildlife, including rare species of flora and fauna.

5.03 Wetlands - Wetlands and wetland values, such as flood damage reduction and fish and wildlife benefits, would be enhanced by the restoration measures in the EQ, nonstructural, and selected plans. Minor adverse impacts are anticipated from the raise of Lake Ashtabula. Approximately 475 acres of wetland at the upper end of the pool would be temporarily inundated. Major change in the composition of the wetland is not expected; however, the areal extent and location may change. The more stringent control of drainage measures in the NED, EQ, nonstructural, and selected plans would help retain the effectiveness of the flood control plans, reduce the quantity of runoff water in the future, and maintain the wildlife values of the area. The construction of subimpoundments at Lake Ashtabula in the EQ and selected plans would also create some wetland areas. This would improve the water quality of Lake Ashtabula and the Sheyenne River and would create fish and wildlife habitat in the flood pool of the reservoir.

5.04 Fish and Wildlife - The fishery of Lake Ashtabula would be adversely affected by the raise, mostly because of the loss of spawning habitat and temporary inundation of 3 river miles. However, various measures in the EQ and selected plans would enhance the fishery and would offset these losses.

These measures include wetland restoration, aerators, subimpoundments, land treatment measures, and control of grazing and cattle access. The nonstructural plan would have no effect on the fishery of the basin. The wildlife would benefit from measures in the EQ, nonstructural, and selected plans that preserve or enhance wildlife habitat, such as shelterbelts and the preservation of riverine habitat. The 5-foot raise of Lake Ashtabula in the NED and selected plans would adversely affect about 900 acres of wildlife habitat. Therefore, 272 acres of woodland and fencing of project lands at Lake Ashtabula are required for compensation. The modifications to Baldhill Dam under the Dam Safety Program would require the replacement of 11 fish-rearing ponds and their operating house located immediately downstream of the dam. Some ponds could be relocated on adjacent Federal lands; others could require additional land purchases. Revised management of Baldhill Dam would result in an increased frequency of floodwater storage. This might create areas of dead vegetation and weed communities, which have limited wildlife value.

5.05 Threatened, Endangered, and Rare Flora and Fauna - None of the plans would have an adverse effect on Federal or State listed species. (See Endangered Species coordination letters in Appendix A.) Some benefits could accrue through measures in the EQ and selected plans which provide for preservation of habitat, especially in the lower basin.

5.06 Sheyenne National Grasslands - No significant adverse effect is expected. The wetland restoration and the preservation of riverine habitat programs in the nonstructural, EQ, and selected plans could affect some areas. Wildlife habitat in the grasslands could be complemented by measures that would maintain habitat values in the lower basin.

5.07 Wildlife Management Areas - No significant adverse effects are expected in these areas from any of the plans. The Baldhill Dam State Game Refuge and Baldhill State Game Management Area would be affected by temporary inundation from the 5-foot raise of Lake Ashtabula in the NED and selected plans. The Wild and Scenic Rivers Program could complement the Mirror Pools Game Management Area in the nonstructural, EQ, and selected plans by providing a wildlife corridor between the more heavily wooded areas in the lower basin.

5.08 Aesthetic Qualities - The NED and selected plans would result in major adverse aesthetic effects, mainly because of the 5-foot raise of Lake Ashtabula which would destroy some of the woodlands and produce more unsightly mudflats. The nonstructural, EQ, and selected plans would provide some aesthetic benefits through environmental measures such as wetland restoration, the Wild and Scenic Rivers Program, and land treatment measures.

5.09 Prairie Chicken - None of the plans would affect the prairie chicken or its habitat.

5.10 Sandhills Environment - None of the plans would affect the sandhills environment.

5.11 Unique Areas - None of the plans would affect any designated or potential unique areas.

5.12 Spring-Fed Streams - None of the plans would have any adverse effects on spring-fed streams. The Wild and Scenic Rivers Program in the non-structural, EQ, and selected plans could complement and preserve these streams.

Cultural

5.13 No known significant cultural resources would be affected by any of the alternatives. Preliminary cultural resource surveys have identified numerous sites in the Sheyenne basin. Additional intensive surveys and testing will be undertaken to assess the significance of these sites and to identify previously unknown resources that might be affected by the alternatives. The primary impacts from the levee, diversion, and ring levees in the NED, nonstructural, EQ, and selected plans result from construction activities. Impacts may also result from inundation from the wetland restoration and subimpoundments in the EQ, nonstructural, and selected plans. Surveys have indicated that 23 sites could be affected by a 5-foot raise of Lake Ashtabula and 1 site would be affected at Dead Colt Creek Dam in the selected plan. Two prehistoric sites may also be affected by the dam modifications under the Dam Safety Program in the NED and selected plans. (It is also expected that the dam would be modified under the no-action plan.) In the nonstructural plan, impacts could result from the flood proofing and relocation components.

Recreation

5.14 Wild, Scenic, and Recreational Rivers Designation (State or Federal) - Flood control measures can affect Wild, Scenic, or Recreational Rivers potentials in several ways. If impacts are significant enough, future designation options may even be foreclosed (e.g., an impoundment area would probably foreclose options on that reach). Also possible are secondary impacts on adjacent reaches of the river not directly affected by the project. Flood control measures could also have positive impacts upon designation (e.g., improvement of water quality through wetland restoration). The NED and nonstructural plans would not significantly affect Wild or Scenic River designation potential of the Sheyenne River. The selected and EQ plans would tend to foster potential for river designation. The nonstructural, NED, selected, and EQ plans would adversely affect small segments of the river near West Fargo, but because this area is already significantly affected by man, the Wild and Scenic River potential of this reach would not be appreciably changed. The EQ, nonstructural, and selected plans would enhance designation potential through such measures as restoration of drained wetlands, more stringent controls of drainage and levee construction (also in NED plan), control of grazing at Lake Ashtabula, construction of subimpoundments at Lake Ashtabula, and encouragement of public ownership/easements of riverine lands for programs such as the creation of parks or forests.

5.15 Hunting and Fishing - None of the plans should have a significant adverse effect on the hunting or fishing activities in the basin. The 5-foot raise of Lake Ashtabula would deteriorate some wildlife habitat and therefore reduce wildlife population levels. However, mitigation lands and management practices would compensate for this loss and would result in little net effect on hunting and fishing activities. Various environmental

considerations in the EQ and selected plans, such as wetland restoration, subimpoundments and aerators at Lake Ashtabula, and low-flow augmentation, would improve the hunting and fishing opportunities in the area.

5.16 Riverine Environment - In the NED and selected plans, about 3 miles of the Sheyenne River would be affected by the raise of Lake Ashtabula, creating some areas of dead vegetation and mudflats. This would also create more areas of bare shoreline and weedy vegetation as a result of more frequent storage of floodwaters. (See Appendix D and other sections of the report for more detail.) The nonstructural, EQ, and selected plans would preserve a significant portion of the Sheyenne River between Kindred and Lisbon if the Wild and Scenic Rivers Program or other public ownership/ easement programs were instituted.

Economic

5.17 The benefit/cost ratios for the selected, NED, EQ, and nonstructural plans are 5.0, 6.0, 6.8, and 7.1, respectively. The selected plan is the most expensive with a total first cost of $80,000,000. The nonstructural plan is the least costly at $41,800,000. The plans with the highest and lowest residual damages are the EQ and selected plans, respectively.

Social

5.18 Impacts on Public Law 91-611, Section 122 Accounts

a. Noise - The noise impacts associated with all of the plans would be short-term and are not considered to be significant.

b. Social Cohesion -

(1) The Effects of Relocations - Under the nonstructural plan, buildings in the 10-year floodplain would be acquired after suffering serious flood damage. In Valley City and Lisbon, this would eventually affect 126 properties. The affected neighborhoods would experience both physical and social disruption when residents and businesses are moved away, perhaps over the course of several floods. However, this may be preferable to allowing damaged structures to remain in the floodplain, unrepaired and perhaps abandoned. A 5-foot raise of Lake Ashtabula (selected plan) would require the acquisition of 115 properties, 88 of which are cabins on the lakeshore. Although many are seasonal residences, it is a reasonable assumption that a sense of community exists in some of these "temporary neighborhoods " and that it would be disrupted or destroyed when cabins are relocated or removed. It is not known if land would be available for all of them to be simply moved back to the new shoreline. Relocations in West Fargo because of the diversion (NED, EQ, nonstructural, and selected plans) involve only two properties and are not expected to significantly change the character or cohesion of the community. The diversion from Horace to West Fargo is not expected to require any relocations. All relocations must comply with Public Law 91-646, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, which should minimize negative consequences for the individual household or business and ensure consistent treatment for all those affected.

(2) Perceived Equity - Probably any solution, including the no-action alternative, will result in some perceptions of unfairness because the causes of flooding and flood damages are seen from opposing viewpoints, with blame of both upstream (drainage and levee practices, for instance) and downstream (unwise floodplain development) river users. There will inevitably be difficulty in arriving at a solution which everyone sees as equitable, with benefits and costs fairly distributed. Because each alternative includes components which attack each of the causes of increased flooding, people may feel that there is an equitable sharing of the social and economic costs of flood control. However, some components are outside Federal jurisdiction for actual implementation; if a part of the eventual solution is not carried out by its local sponsor, there will again be a sense of inequity and also of betrayed trust. This could have a serious effect on the region's future ability to reach compromises in solving its flood problems.

(3) Acceptability of Project Components - At present, there are no known threats to social cohesion in terms of significant opposition to any of the alternatives. This is a change from an earlier stage of the Sheyenne study, when there was strong, vocal opposition against the proposed Kindred Reservoir. The present alternatives have been developed largely in response to that opposition. However, some pro-reservoir sentiment clearly exists, and a focal point for controversy might be the Fargo-Moorhead Forum's perception that diversions (as in each of the present plans) will simply not be an adequate flood control solution. The city of Grand Forks has also expressed concern that diversions may worsen downstream flooding. Although these perceptions may not agree with those of technical experts, they could cause considerable controversy. Valley City has indicated (December 1980) that it is not interested in being the local sponsor of any relocations (the nonstructural plan); however, a plan of gradual relocations might be acceptable to the affected citizens if available promptly after they have experienced flood damages.

(4) Fiscal Capacity of Sponsors - It is not presently possible to accurately predict the impacts of the alternatives on the various sponsors because (a) costs are not known for all components of each plan (such as flood proofing in the nonstructural, EQ, and selected plans or ring levees in each plan); (b) the cost of some components would be shared between several local sponsors (such as the West Fargo levees and diversions, which would be paid for by an undetermined combination of State Water Commission, city of West Fargo, and SE Cass Water Management District funds); (c) some components would not be paid for by any local sponsor, but would be the financial responsibility of individuals (such as removal of certain private levees); and (d) current and future financial positions, including tax bases, bonding abilities, and competing expenditures, are not known for all potential local sponsors.

When costs have been more thoroughly developed and local sponsors or co-sponsors identified (after this EIS/GDM is reviewed by the public), it will be possible to see what effect the costs will have on the fiscal bases of those sponsors, and hence on their taxable population. This information will be collected during Phase II and presented in an EIS Supplement if the impacts are found to be significant.

(5) Transportation - The diversion at West Fargo/Riverside in the nonstructural, EQ, NED, and selected plans would require construction of the following five new bridges:

- Horace Road, north of I-94
- 13th Avenue South, near I-94
- Main Avenue West, near Bonanzaville
- BNRR, south of sewage lagoons
- 12th Avenue North, at the Sheyenne River

Although construction of each road bridge might take 3 or 4 months, the necessary detours and bypasses are expected to cause minimal impacts on travel time or safety. Assuming Main Avenue traffic would be rerouted onto its two frontage roads around the construction site, there would be temporary congestion in those commercial and industrial areas. The railroad bridge would not interrupt service on the main line. Although the bridge might take more than a year to build, Burlington Northern would construct a bypass before disrupting the existing track. The only permanent road closures will be the Main Avenue West frontage roads, which will cause insignificant changes in access to the businesses located nearby, and Third Avenue NW, located in a new industrial area, which should not affect the remaining industrial sites. The diversion from Horace to West Fargo in the EQ, NED, and selected plans would require modification to the present I-94 bridges; significant disruption during one construction season is anticipated. Other roads should not be significantly disrupted during construction, but the diversion is designed to allow flows over the roads during floods. This would require some detours, although probably fewer than those needed under present flood conditions. The 5-foot raise of Lake Ashtabula in the selected plan would require the raise or abandonment of the following bridges: Ashtabula Bridge, Wesley Acres Camp, and Sibley Crossing.

c. Aesthetic Values - The impacts on aesthetic values are discussed earlier in this section (see paragraphs 5.08 and 5.16).

d. Man-Made Resources - The impacts on these resources are discussed earlier in this section (see paragraphs 5.06, 5.07, 5.13, and 5.18).

e. Natural Resources - The impacts on these resources are discussed earlier in this section (see paragraphs 5.02 to 5.07, and 5.09 to 5.16).

f. Air - The impacts on air quality associated with all of the plans would be short-term and are not considered to be significant.

g. Water - The 5-foot raise of Lake Ashtabula would neither improve nor degrade water quality because the permanent pool would not be affected. Those features which affect runoff, such as wetland restoration, better land use planning, and control of drainage, would result in some improvement in water quality through reductions in erosion and nutrient loading (see paragraphs 5.03, 5.04, 5.12, 5.15, and 5.16, and Appendix H).

6.00 PUBLIC INVOLVEMENT

Public Involvement Program

6.01 A Notice of Intent to Prepare a Draft Environmental Impact Statement for a Proposed Flood Damage Reduction Project, Sheyenne River, North Dakota, appeared in the Federal Register on 15 May 1980. This notice invited participation in the scoping process by anyone who was interested.

6.02 As part of the study and scoping process, the views of the public were actively solicited throughout the course of the study. Individuals, groups, civic organizations, and government bodies were brought into the study process through a broadly-based public information program, with regular communication on project matters. In addition, a Citizens Committee was formed in June 1976. The committee meets periodically to hear and discuss presentations on the water resource development plans and issues in the basin. These meetings are open to the public. In August 1980, the Stage 2 Documentation Report was distributed to the public for review and comment. Throughout the study, coordination has been maintained between the St. Paul District and Federal, State, and local government agencies and interested groups, agencies, and citizens. A detailed discussion of the public involvement program is presented in Appendix A.

Required Coordination

6.03 Following coordination of the Draft EIS with appropriate agencies, groups, and individuals, a public meeting will be held. Comments received at the meeting or by letter concerning this Draft Design Memorandum and EIS will be used in preparation of the final planning report and EIS. Coordination with appropriate agencies and groups will continue throughout the study process.

6.04 Further coordination is required with the Fish and Wildlife Service and other agencies concerning the implementation of the mitigation plan. Wildlife management opportunities on project lands would be investigated and utilized to the maximum extent possible. Implementing agencies for components of the selected plan that are not the responsibility of the Corps of Engineers have not been identified.

6.05 In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Draft EIS contains a summary of the biological assessment of impacts on federally-listed or proposed threatened or endangered species which may be affected by the project.

6.06 The results of all cultural resource investigations will be coordinated with the State Historic Preservation Office and the National Park Service. The comments of the Advisory Council on Historic Preservation will be requested in accordance with 36 CFR 800 for all significant cultural resources that may be affected by the proposed project.

6.07 Continued coordination with Federal, State, and local agencies will be necessary to ensure that a socially and environmentally acceptable plan is implemented.

6.08 Because the proposed plan involves placement of fill material in waters of the United States, a Section 404(b)(1) Evaluation of the effects of the fill placement has been prepared and circulated with these draft documents in compliance with the Clean Water Act of 1977, as amended (Public Law 92-500). The General Design Memorandum and Final EIS, containing the Section 404(b)(1) Evaluation, will be submitted to Congress pursuant to Section 404(r) of the Clean Water Act. All plan features are included in the EIS discussions; however, only those to be implemented by the Corps are covered by the Section 404(b)(1) Evaluation. Other plan features may also involve Section 404 regulated activities. The implementing agency would be required to obtain the Section 404 permits in these cases.

EIS Distribution

6.09 The following agencies, organizations, and individuals will be sent copies of this EIS.

State Conservationist
Bismarck, ND

U.S. Forest Service
Missoula, MT

Deputy Reg. Forester
Missoula, MT

ND Coordinator, Custer NF
Bismarck, ND

Chief, River Basin Pln. Br.
Washington, D.C.

Deputy Asst. Sec. for Env. Affairs
Washington, D.C.

Director
Office of Fed. Activities
Washington, D.C.

Region VIII
U.S. EPA
Denver, CO

Garrison Diver. Conserv. Dist.
Carrington, ND

Div. of Cultural Programs
Denver, CO

Chief, Interagency Arch. Serv.
Denver, CO

Dept. of Health & Human Serv.
Washington, D.C.

Dept. of Health & Human Serv.
Denver, CO

Advisory Council on Historic Pres.
Washington, D.C.

Administrator
HUD, Region VIII
Denver, CO

Asst. Sec. for Prog. Policy
Washington, D.C.

Regional Director
U.S. Fish and Wildlife Service
Lakewood, CO

U.S. Fish & Wildlife Service
Bismarck, ND

Bureau of Indian Affairs
Aberdeen, SD

Bureau of Land Management
Dickinson, ND

Liaison Officer
Bureau of Mines
Bismarck, ND

Director
National Park Service
Denver, CO

USGS, Conserv. Div.
Denver, CO

Asst. Dir., Central Region
U.S. Geological Survey
Denver, CO

District Chief
U.S. Geological Survey
Bismarck, ND

Director
Water Resources Management Div.
Seattle, WA

U.S. Dept. of Transportation
Denver, CO

Commander (dcw)
Second Coast Guard District
St. Louis, MO

N.D. Dept. of Agriculture
Bismarck, ND

Department of Anthropology
Grand Forks, ND

Attorney General's Office
Bismarck, ND

Clearinghouse-Fed. Aid
Bismarck, ND

Dr. Gary Johnson, Reg. EIS
Bismarck, ND

Energy Specialist
Bismarck, ND

Dr. Robert Johnson, State Forester
Bottineau, ND

District Forester
Bottineau, ND

Commissioner
N.D. Game & Fish Dept.
Bismarck, ND

North Dakota Geological Survey
Grand Forks, ND

Administrator
ND Dept. of Health
Bismarck, ND

North Dakota Hwy. Department
Bismarck, ND

State Historical Society
Bismarck, ND

State Historic Pres. Officer
Bismarck, ND

Executive Director
ND Indian Aff. Comm.
Belcourt, ND

North Dakota Land Dept.
Bismarck, ND

Chairman
Governor's Natural Res. Council
Bismarck, ND

Director
N.D. State Planning Div.
Bismarck, ND

Reclamation Director
Public Serv. Comm. of ND
Bismarck, ND

Executive Officer
ND State Outdoor Rec. Agency
Mandan, ND

Executive Secretary
North Dakota Soil Cons. Comm.
Bismarck, ND

Chief Engineer
North Dakota Water Commission
Bismarck, ND

Documents Librarian
Fort Collins, CO

North Dakota State University Library
Fargo, ND

University of North Dakota Library
Grand Forks, ND

Thermodsgard Law Library
Grand Forks, ND

Veterans Memorial Library
Bismarck, ND

Old West Regional Commission
Rapid City, SD

Lake Agassiz Reg. Council
Fargo, ND

National Audubon Society
Jamestown, ND

National Audubon Society
Madison, WI

North Central Reg. Vice Pres.
Omaha, NE

Director
Institute for Ecol. Studies
Grand Forks, ND

Environmental Defense Fund Inc.
Washington, D.C.

H. Paul Friesema
Indianapolis, IN

North Central Region
Natl. Wildlife Federation
Mandan, ND

North Central Plan. Council
Devils Lake, ND

North Dakota Nat. Science Soc.
Bismarck, ND

President
North Dakota Wildlife Federation
Watford City, ND

Chairman, Dakota Group
Sierra Club
Minot, ND

Executive Vice President
North Dakota Water Users Assoc.
Minot, ND

Izaak Walton League of America
Arlington, VA

The Waterways Journal
St. Louis, MO

North Central Field Rep.
Wildlife Management Inst.
Firth, NE

Water Res. & Coastal Cons. Prog.
National Wildlife Federation
Washington, D.C.

Public Views and Responses

6.10 The original Kindred Lake flood control project was authorized by Congress in 1970, and a Final Environmental Impact Statement for the project was completed in that year. In response to official comments on the interim survey reports by the Departments of the Interior, Agriculture, and others, a Kindred Lake Restudy was initiated in 1972. This study addressed potential groundwater problems, the effects of reservoir storage on water quality control, and the possible bank slope stability problems resulting from impoundment of water in the authorized Kindred Lake. The restudy did confirm that some groundwater level increases and shore erosion could be expected with reservoir development.

6.11 In 1976, a complete reevaluation of alternatives was undertaken to address issues regarding plan selection that were unresolved at the time of authorization or which arose after authorization. The study procedures and plan selection must address current Water Resources Council criteria. Coordination for the current study has involved telephone contacts, letters, and several meetings with local, State, and Federal interests and the Sheyenne River Citizens Committee.

6.12 During the public involvement program, many public views were expressed that had a major influence on the study and that were considered in the decision-making process. Two primary concerns were the reduction of flooding problems and the minimization of social impacts. There was considerable local, State, and Federal opposition to the authorized Kindred Dam, primarily because of the large quantity of land needed for the project. Concern was expressed over the loss of wildlife habitat, social and cultural impacts, and locating the project where the actual flood damages occur. All of these concerns and others were considered in the plan formulation process and in identification of the selected plan.

List of Preparers

Name	Expertise	Experience	Role in Preparation of EIS
Mr. Robert Anfang	Forest Ecology	2 years, Research Assistant, University of Minnesota; 1 1/2 years Forestry Technician and Biological Laboratory Technician, U.S. Forest Service; 7 years, Forester, St. Paul District, Corps of Engineers.	EIS Coordinator. Biological evaluation; reviewed documents prepared by contractor; prepared EIS, mitigation requirements.
Dr. William T. Barber	Systematic Botanist/Plant Ecologist	17 years of university teaching and research in systematic botany and plant ecology. Serves as a consultant in revegetation and vegetation inventory and management. Present address-North Dakota State University.	Consultant; Existing Environmental Setting and Vegetation/ Groundwater Effects contract reports.
Mr. Richard Beatty	Fisheries Biologist	2 years Field Biologist, Aquatic Life Consultants; 2 years Field Biologist, U.S. EPA; 3 years EIS studies, St. Paul District, Corps of Engineers.	Prepared 404(b)(1) Evaluation; technical assistance on water quality.
Mr. Ralph Berger	Civil Engineer	3 years Civil Engineer, St. Paul District, Corps of Engineers; 5 years design, Chicago and North Western Railroad.	Design of structures and alternatives.
Mr. Robbin Blackman	Supervisory Fisheries Biologist	11 years EIS Studies, Corps of Engineers.	EIS Coordinator.
Dr. Mary C. Bromel	Pathogenic Bacteriologist/ Microbial Ecologist	Ten years research at North Dakota State University on microbiological water quality of Sheyenne River, Red River, rural wells, and Lake Metigoshe. Consultant to three municipalities on sewage treatment facilities, IJC Committee on Garrison Diversion Impact Study, and EPA on coal mining impact on Knife River basin.	Consultant: Existing Environmental Setting contract report.

Name	Expertise	Experience	Role in Preparation of EIS
Dr. John A. Brophy	Geologist	30 years of professional experience, teaching, and research at North Dakota State University in quaternary geology, geomorphology, and environmental geology.	Consultant: Vegetation/ Groundwater Effects contract report.
Dr. J. Frank Cassel	Ornithologist/ Mammalogist	35 years of university teaching and research, with emphasis on bird and mammal population ecology.	Consultant: Existing Environmental Setting contract report.
Mr. Leonard Cernohous	Fish and Wildlife Biologist	9 years Fish and Wildlife Biologist with U.S. Fish and Wildlife Service.	Prepared Fish and Wildlife Coordination Act Report; fish and wildlife evaluation; mitigation requirements.
Ms. Suzanne Gaines	Sociologist	2 years Sociologist, St. Paul District, Corps of Engineers; 1 year research assistant, Arizona State University Sociology Department and Survey Research Laboratory; 3 years teaching assistant, University of Minnesota Sociology Department.	Prepared social/economic impacts and alternative evaluations.
Dr. Harold Goetz	Range Ecologist/ Plant Ecologist	18 years of teaching and research at North Dakota State University in plant and range ecology. Consultant in mined land reclamation, vegetation inventory, and natural resource management.	Consultant: Existing Environmental Setting and Vegetation/ Groundwater Effects contract report.

Name	Expertise	Experience	Role in Preparation of EIS
Mr. John Kittleson	Biologist	1 year Biologist, St. Paul District, Corps of Engineers; 1 year Peace Corps Biology teaching; 2 years Naturalist, National Park Service.	Prepared Monetary Evaluation of Lake Ashtabula and Kindred; participated in wetland delineation.
Mr. Edward L. McNally	Supervisory Landscape Architect	9 years Landscape Architect, St. Paul District, Corps of Engineers; 1 year research assistant University of Wisconsin.	Prepared Recreation Appendix; designed recreation features of alternatives; recreation impacts.
Mr. David Miller	Sociologist	2 years Research Assistant, Rural Sociology Department, University of Minnesota; 4 years Sociologist, St. Paul District, Corps of Engineers.	Social analysis studies coordinator.
Mr. Michael O'Keefe	Wildlife Biologist	3 1/2 years EIS studies, St. Paul District, Corps of Engineers.	Assisted HEP field studies.
Mr. John Peterka	Aquatic Ecologist/ Ichthyologist	17 years of teaching and research at North Dakota State University in limnology, fisheries biology, and ichthyology.	Consultant: Existing Environmental Setting contract report.
Ms. Terry J. Pfutzenreuter	Archaeology	5 years Archaeologist, Minnesota Historical Society; 1 year Archaeologist, Corps of Engineers.	Reviewed and coordinated cultural resources technical report. Cultural evaluation.
Ms. Jody Rooney	Economic Planner	7 years Economist, St. Paul District, Corps of Engineers.	Economics evaluation.

Name	Expertise	Experience	Role in preparation of EIS
Mr. Clifford Schlueter	Hydraulic Engineer	4 years Hydraulic Engineer, 1 year Engineer Trainee, St. Paul District, Corps of Engrs.	Hydraulic design of alternatives.
Mr. William Spychalla	Water Resources Management/Civil Engineer	11 years Water Resources Investigations, St. Paul District, Corps of Engineers; 4 years officer in charge of field survey teams, National Geodetic Survey.	Project manager. Reviewed contractors' reports; developed alternatives.
Mr. John M. Wiehe	Vertebrate Ecologist	8 years graduate and post-graduate experience at North Dakota State University as an interpreter, investigator, author, and environmental consultant. Has investigated (and directed field parties) numerous terrestrial vertebrate communities, resulting in several publications. Currently employed by Ecological Analysts, Inc., Northbrook, Illinois.	Consultant: Existing Environmental Setting contract report.

Index, References and Appendixes
(The selected plan is recommended)

Subjects	Study Documentation: Environmental Impact Statement (Paragraph)	Main Report (References Incorporated, Page)	Report Appendixes (References Incorporated)
Affected Environment	EIS-14		B,C,D,E,F,G,H, I,N
Alternatives	EIS-5 through EIS-11	51-98	D,J,L,M
Areas of Controversy	EIS-1, EIS-2		A
Comparative Impacts of Alternatives	EIS-11, EIS-12 EIS-19 through EIS-24	77	L,M,N
Cover Sheet	EIS-1		
Environmental Conditions	EIS-14 through EIS-18	16-18	B,E,F,H,I
Environmental Effects	EIS-19 through EIS-24	77, 89, 90	D,L,M,N
List of Preparers	EIS-29 through EIS-32		
Major Conclusions and Findings	EIS-1	88-98	
Need for and Objectives of Action	EIS-4, EIS-5		A
Planning Objectives	EIS-4, EIS-5	6, 41	A,D,M
Plans Considered in Detail	EIS-9 through	70-75 79-98	L,M
Plans Eliminated from Further Study	EIS-5 through EIS-8	52-59	L,M

Index, References and Appendixes
(The selected plan is recommended)

Subjects	Environmental Impact Statement (Paragraph)	Main Report (References Incorporated, Page)	Report Appendixes (References Incorporated)
Public Concerns	EIS-4	6-8	A,D,M
Public Involvement	EIS-25, EIS-26	4	A
Public Involvement Program	EIS-25		A
Public Views and Responses	EIS-28	43, 44	A
Relationship to Environmental Requirements	EIS-2, EIS-3		M,N
Required Coordination	EIS-25, EIS-26		A
Woodlands	EIS-12, EIS-13 EIS-15, EIS-19		D,N
Wetlands	EIS-12, EIS-13 EIS-15, EIS-19		D,N
Fish and Wildlife	EIS-12, EIS-13 EIS-15, EIS-19 EIS-20		D,N
Threatened, Endangered, and Rare Flora and Fauna	EIS-12, EIS-13 EIS-15, EIS-20		D,N
Sheyenne National Grasslands	EIS-12,EIS-13 EIS-15, EIS-20		D
Wildlife Management Area	EIS-12, EIS-13 EIS-15, EIS-20		D,N
Aesthetic Qualities	EIS-12, EIS-13 EIS-15, EIS-20		D,I
Cultural	EIS-12, EIS-13		E

Index, References and Appendixes
(The selected plan is recommended)

Subjects	Environmental Impact Statement (Paragraph)	Main Report (References Incorporated, Page)	Report Appendixes (References Incorporated)
Prairie Chicken	EIS-12, EIS-13 EIS-16, EIS-20		D
Sandhills Environment	EIS-12, EIS-13 EIS-16, EIS-20		D
Unique Areas Spring-Fed Streams	EIS-12, EIS-13 EIS-16, EIS-21		D
Wild and Scenic Rivers	EIS-12, EIS-13 EIS-16, EIS-21		D,I
Hunting and Fishing	EIS-12, EIS-13 EIS-17, EIS-21 EIS-22		D,I
Riverine Environment	EIS-12, EIS-13 EIS-17, EIS-22		D
Public Law 91-611 Section 122 Accounts	EIS-12, EIS-13 EIS-17, EIS-22		F
Noise	EIS-12, EIS-13 EIS-17, EIS-22		
Aesthetic Values	EIS-12, EIS-13 EIS-17, EIS-24		D
Community Cohesion	EIS-12, EIS-13 EIS-17, EIS-22 EIS-23		
Desirable Community Growth	EIS-12, EIS-13 EIS-17		
Tax Revenues	EIS-12, EIS-13 EIS-17		
Property Values	EIS-12, EIS-13 EIS-17		
Public Facilities	EIS-12, EIS-13 EIS-17		
Public Services	EIS-12, EIS-13 EIS-17		
Employment/Labor Force	EIS-12, EIS-13 EIS-17		

Index, References and Appendixes
(The selected plan is recommended)

Subjects	Environmental Impact Statement (Paragraph)	Main Report (References Incorporated, page)	Report Appendixes (References Incorporated)
Business and Industrial Activity	EIS-12, EIS-13 EIS-17		
Man-Made Resources	EIS-12, EIS-13 EIS-18, EIS-24		D,E,F
Natural Resources	EIS-12, EIS-13 EIS-18, EIS-24		D,E
Air	EIS-12, EIS-13 EIS-18, EIS-24		
Water	EIS-12, EIS-13 EIS-18, EIS-24		D
Significant Resources	EIS-14 through EIS-18		D,E,F,I,N
Statement Recipients	EIS-26, EIS-27		
Study Authority	EIS-4		
Summary	EIS-1 through EIS-3		
Table of Contents	EIS-ii		
Unresolved Issues	EIS-2		
Without Conditions (No Action)	EIS-7, EIS-8	31-36	B,C,D,E,F, G,H,I,N

EXHIBIT 1

PRELIMINARY

404(b)(1) *Evaluation of*
Proposed Plan for Flood Control
Sheyenne River, North Dakota

As required by Section 404(b)(1) of the Clean Water Act of 1977 (Public Law 95-217), the following is an evaluation of the proposed construction and fill activity for the Sheyenne River, North Dakota, flood control project.

1. Project Description

a. Location. The project is located on the Sheyenne River in eastern North Dakota near the cities of West Fargo, Valley City, and Horace.

b. General description. The proposed project is composed of two principal components: (1) the West Fargo Diversions and (2) the modifications to the Baldhill Dam (Lake Ashtabula)(Plate 2). The proposed diversion structures would have three inlets/outlets on the Sheyenne River in the area of West Fargo and Horace (see Plates 3 and 4). In addition, three cross-channel retarding structures would be built. The modifications to the Baldhill Dam would consist of raising the elevation of the present structure, removing or modifying the existing floodgate on the right (west) side of the dam, and constructing a new floodgate and channel on the left (east) side (Plate 5).

c. Authority and purpose. The Flood Control Act of 31 December 1970 (Public Law 91-611), Title II, Section 201, authorizes the Secretary of the Army, acting through the Chief of Engineers, to construct and implement the Kindred Lake project and other improvements in the Sheyenne River basin. In 1976, a postauthorization study was initiated to reevaluate the problems and needs of the basin and develop alternative solutions to flood damage and related problems.

d. General description of dredged or fill material.

(1) General characteristics of material.

Diversion: Compacted earth fill and riprap would be used for the cross-channel structures. Culverts or gated structures would be placed in the earth dikes and steel sheetpile would be used to help stabilize the earth embankment. Riprap consisting of random fill and rock would be used to control erosion.

Dam: The addition to the sides of the dam would be riprap and earth fill. The temporary cofferdams would be earth-fill structures with steel sheetpile. The present spillway would be modified or removed and the channel filled with compacted earth. The cofferdam used for the existing spillway could become part of the dam after construction or could be removed.

(2) Quantity of material proposed for discharge.

Diversion: Approximately 2,000 cubic yards of earth fill and riprap would be needed at each diversion opening and for the cross-channel structure. Steel sheetpile may also be used.

Dam: Approximately 110,000 cubic yards of earth fill would be required for the cofferdams. About 575,000 cubic yards of earth fill would be required to raise the dam, extend the sideslopes, and, if recommended, fill the existing spillway and channel. Steel sheetpile may also be used. Not all of this material would be placed below the waterline.

(3) Source of material. The earth fill and riprap material would be obtained from the excavation for the new spillway and from approved borrow sites. Concrete and steel sheetpile would be commercially purchased.

e. Description of the proposed discharge sites.

(1) Location (Plates 2, 3, 4, and 5)
Diversion: The areas to be riprapped and the location of the channel structure are at river miles 24, 29, and 42 of the Sheyenne River.

Dam: The construction would occur at Baldhill Dam (Lake Ashtabula), located at river mile 271 of the Sheyenne River.

(2) Size.
Diversion: The total area affected is about 3 acres in size.

Dam: The total area affected is about 10 acres in size.

(3) Type of site.
Diversion: The rock riprap and its foundation material would be placed in open water along the riverbank from above the waterline to the riverbed. The compacted earth-fill structures would be placed in open water across the river channel from the riverbed to the top of the bank. Gated structures would be used to control the flow of water.

Dam: The placement of fill to enlarge the dam would occur in open water along the lakeward side of the dam. The cofferdams would be placed in open water directly upstream of the existing and proposed spillways. The riprap earth-fill material would be placed in open water from above the waterline to the riverbed at the junction of the river channel and the proposed left bank channel. The existing spillway and outlet channel is open water consisting of concrete, rock, and earth sides and bottom.

(4) Type of habitat.
Diversion: The habitat in the area consists of open water associated with the river and has a sand, silt, and clay bottom.

Dam: The habitat in the area consists of open water associated with Lake Ashtabula and the river. The bottom is mostly silt and clay.

(5) Timing and duration of discharge. Fill activities would be associated only with the construction phase of the project, which is expected to begin about 1990.

f. Description of disposal method.
Diversion and Dam: The fill material would be brought in and mechanically discharged from barges and trucks.

Diversion: At river miles 24, 29, and 42, riprap would be placed along the bank of the main channel on either side of the opening to the diversion canal. Foundation material would consist of compacted earth fill covered by large-sized riprap. At river miles 42, 29, and 24 near the diversion channels, a flow regulation structure would be constructed across the main channel (Plates 3 and 4). These would be compacted earth-fill and riprap structures with gated culverts and would be anchored at each end to rock riprap on the channel banks. Both the riprap and structures would have a foundation layer of compacted earth fill.

Dam: The height of the dam would be raised 3.5 feet, and the base would be expanded approximately 600 feet. On the upstream side of the dam, the fill material would consist of rock riprap. In addition to raising the height of the structure, the existing spillway and channel on the right side may be removed and replaced with compacted earth fill and riprap. A new spillway and channel would be constructed on the left side of the dam. During the construction phase, cofferdams would be placed around the upstream side of the spillways. The cofferdam placed for the existing spillway could be either temporary or permanent and could become part of the dam structure after construction.

II. Factual Determinations (Section 230.11)

a. Physical substrate determinations.

(1) Substrate elevation and slope.
Diversion: The proposed construction area has a typical riverine configuration: relatively steep-sided banks and a flat central region. The riprap would replace the sand and clay now on the channel bank. The cross-channel structures would cause a change in bottom geometry over a small area.

Dam: The side of Baldhill Dam where the rockfill would be placed has a height of about 40 feet and a 1:3 slope. The cofferdams would butt up against the dam and the lakeshore and would run along the relatively flat lake bottom. The bathymetric configuration at the junction downstream is similar to that found near the diversion described above. The riprap would replace the sand and clay now on the channel bank. If the existing spillway is filled, it would modify a small area.

(2) Sediment type.
Diversion: The sediment in this area consists mostly of river-deposited silts and clays.

Dam: The sediment in this area consists of gravel, sand, silt, and clay in varying quantities.

(3) Dredged/fill material movement. The fill material would be relatively stable and is not expected to move after placement.

(4) Physical effects on benthos. Some benthic organisms would be buried by the fill material. However, recolonization should occur fairly rapidly on the new substrate. In addition, the coarser texture of the fill material would provide more diverse and probably higher quality habitat than what is presently found in the area.

(5) Other effects. See other portions of this evaluation for a discussion of other effects.

(6) Actions taken to minimize impacts. The use of coarse fill and material with a composition similar to the existing substrate would reduce impacts. The effects of fill placement are not expected to be significant.

b. Water circulation, fluctuation, and salinity determinations.

(1) Water.

(a) Salinity. There would be no effect on salinity.

(b) Water chemistry. There would be no effect on water chemistry.

(c) Clarity. The clarity of the water in the immediate area would be reduced temporarily. Increased turbidity would be localized and would have no long-term effects.

(d) Color. Increased turbidity would temporarily affect the water color; however, no long-term or significant effects are expected.

(e) Taste. There would be no effect on taste.

(f) Dissolved gas levels. There would be no effect on dissolved gas levels.

(g) Nutrients. Because the fill material is essentially the same as the existing substrate at the disposal site, no effects are anticipated.

(h) Eutrophication. The fill activities would not affect the eutrophication level of the river or Lake Ashtabula.

(2) Current patterns and circulation.

(a) Current patterns and flow.
Diversion: The cross-channel structures would cause a slight constriction of flow during low and moderate water stages. At high flows, the water would be channeled through the diversion structures.

Dam: The proposed project is not expected to cause variations in the current or circulation patterns of the river.

(b) Velocity.
Diversion: The velocity in the river would be reduced in the area of the diversions during moderate and high flows. There would be little effect on low flows.

Dam: Velocities would not be affected.

(c) Stratification. Fill activities would have no effect on stratification.

(d) Hydrologic regime. The fill activities would reduce downstream flood flows and stages.

(3) Normal water level fluctuations. The revised operating plan of the lake caused by fill activities would increase water level fluctuation in Lake Ashtabula and decrease fluctuations downstream. The fill activities at the diversions would decrease water level fluctuations in the main river channel by diverting flood flows.

(4) Salinity gradients. Salinity would not be affected.

(5) Actions that will be taken to minimize impacts.
Diversion and Dam: The use of compacted earth fill material and riprap with particle size greater than silt and the use of mechanical disposal techniques would minimize the impacts of turbidity.

c. Suspended particulate/turbidity determinations.

(1) Expected changes in suspended particulates and turbidity levels in vicinity of disposal site.
Diversion and Dam: Fill material would consist of sand, rock, sheetpile, earth fill, and concrete, none of which should release constituents in overlying water that would cause alterations of biological communities. Some exchange with disturbed sediments may occur during construction, but any adverse impact would be short-term and minor. Increased turbidity during construction caused by the suspension of minor amounts of small particles in the fill material and resuspension of bottom sediment material would be the only water quality problems expected to be caused by the project. This increase would be short-term and would not result in significant effects.

(2) Effects on chemical and physical properties of the water column.

(a) Light penetration.
Diversion and Dam: Some increase in turbidity and suspended solids would be expected during construction. This condition would not be severe, however, and would end with the completion of the construction phase.

(b) Dissolved oxygen. The fill activities would have no effect on dissolved oxygen levels.

(c) Toxic metals and organics. No effect. The fill material is essentially the same composition as the existing substrate and includes large rock.

(d) Pathogens. No effect.

(e) Aesthetics.
Diversion: Some trees and shoreline vegetation would be removed for the diversion openings and the placement of riprap. The cross-channel structures would detract from the visual appearance of the river.

Dam: During construction, the cofferdams would detract from the visual appearance of Lake Ashtabula.

(3) Effects on biota.

(a) Primary production, photosynthesis. The fill activities would have little effect on these items.

(b) Suspension/filter feeders. Placement and removal of the fill material would destroy or displace some of these aquatic organisms. However, impacts are expected to be minor. The permanent fill would have no effect.

(c) Sight feeders. Impacts would be similar to those expected for the filter feeders.

(4) Actions taken to minimize impacts. The use of clean fill with a composition similar to that of the existing substrate and the use of nonhydraulic methods of placement would reduce impacts.

d. Contaminant determinations. The fill material would consist of rock, gravel, steel, concrete, and material similar to the existing substrate. Although an analysis has not been conducted, it is not anticipated that any new contaminants would be introduced or released as a result of the fill activities.

e. Aquatic ecosystem and organism determinations.

(1) Effects on plankton. Minor impacts would result from the placement and removal of the fill material. Most of these effects would result from the displacement of organisms.

(2) Effects on benthos.
Diversion: Some marginal habitat would be destroyed by the placement of the riprap and cross-channel structures. However, these structures would provide improved, more diverse habitat for benthic organisms.

Dam: The fill material at Baldhill Dam would bury existing communities but would provide new habitat similar to that which presently exists.

(3) Effects on nekton. The fill material would cause a minor disruption of the nekton, resulting from increased turbidity.

(4) Effects on aquatic food web. The fill activities would have little effect on the aquatic food web or production.

Diversion: The cross-channel structures have the potential to block movement of plant or animal species. The size of the openings, however, should preclude this from happening. During high flows, organisms would be able to go through the diversion channel. Habitat in the fill area is generally not conducive to feeding, spawning, or breeding.

Dam: Raising the height of the dam would provide no greater hindrance to biotic movement than already exists. The area which would be covered is marginal habitat for aquatic organisms. The rock riprap would probably provide improved habitat.

(5) Effects on special aquatic sites.

(a) Sanctuaries and refuges. Not applicable.

(b) Wetlands. Not applicable.

(c) Mudflats. Not applicable.

(d) Vegetated shallows. Some areas along the shore vegetated mostly with grass, sedge, or rush would be destroyed by the placement of fill.

(e) Coral reefs. Not applicable.

(f) Riffle and pool complexes.
Diversion: The river in this area is uniform in depth, has a clay-silt bottom, and is not considered a riffle/pool complex.

Dam: The outlet channel downstream of the dam would be filled. This area is fairly uniform in depth, has a rock bottom in areas, and is not considered a riffle/pool area.

(6) Threatened and endangered species. Although the bald eagle and peregrine falcon may migrate through the area, they do not nest here. No effects on these species or their habitat are expected. No State threatened or endangered species would be affected.

(7) Other wildlife. There would be minor effects on terrestrial or aquatic organisms predominantly as a result of increase in turbidity during placement and removal of the fill.

(8) Actions to minimize impacts. The use of clean fill, with a composition similar to the existing substrate in the area, and placement/removal by mechanical means would reduce the impacts.

f. Proposed disposal site determinations.

(1) Mixing zone determination. The mixing zone would be small and would not constitute a significant problem because of the nature of the fill material and its placement by mechanical means. No liquid material would be discharged during construction.

(2) Determination of compliance with applicable water quality standards. The Sheyenne River has been classified by the State of North Dakota as a Class IA stream. The waters of this class "permit the propagation and/or life of resident fish species and shall be suitable for boating, swimming, and other water recreation." Fill activities would conform to applicable State standards and should have no effect on this classification. During construction, turbidity or suspended solids levels could exceed legally acceptable limits, but this would be a temporary situation and would have no long-term environmental or water quality effects.

(3) Potential effects on human use characteristics.

(a) Municipal and private water supply. There would be no effect on water supplies except for residences that pump river water for watering lawns. They may experience some decline in water if the river is diverted during construction.

(b) Recreational and commercial fisheries. The fill activities would have little effect on fishing except at the construction site. The openings in the diversion structure should not prohibit fish movement. The structure at the dam should not restrict fish movement any more than existing conditions do.

(c) Water-related recreation. The cross-channel structures at the diversions would restrict canoe passage and would necessitate a portage.

(d) Aesthetics.
Diversion: The cross-channel structures and riprap would produce adverse aesthetic impacts in the urban environment. However, these effects are expected to be minor.

Dam: The fill activities would produce some adverse aesthetic impacts. However, because of the existing dam and modified setting of the area, these impacts are not expected to be major.

(e) Parks, National and Historic Monuments, National Seashores, wilderness areas, research sites, and similar preserves. Not applicable.

g. Determination of cumulative effects on the aquatic ecosystem. The impacts resulting from placement of the fill are expected to be minor. They would result from the burying and displacement of aquatic species and the increases in turbidity in the construction area and immediately downstream. This turbidity would affect the feeding and survival of some aquatic organisms.

h. Determination of secondary effects on the aquatic ecosystem. Secondary impacts would include the beneficial value of a more diverse and higher quality substrate provided by the riprap. The cross-channel structures should not significantly affect aquatic organisms.

III. Findings of Compliance or Noncompliance with the Restrictions on Discharge

a. Adaption of the Section 404(b)(1) guidelines to this evaluation. This evaluation is based on the Section 404 guidelines.

b. Evaluation of availability of practicable alternatives to the proposed discharge site which would have less adverse impact on the aquatic ecosystem. Alternative flood damage reduction measures were discussed in the EIS and Design Memorandum. Alternatives are rather limited and would not significantly reduce the impacts. The dam has to be upgraded, even under the no action conditions, to conform to present standards, and alternatives to the modification of the dam are therefore not practical. The impacts resulting from the diversion structures could not be significantly reduced by changing their locations because the habitat in the area is consistent in type. The no action alternative would reduce the environmental impacts. However, it would not alleviate flood damages to an acceptable degree and is therefore not a practical alternative.

c. Compliance with applicable State water quality standards. The activities would comply with State standards with the possible exception of turbidity or suspended solids levels during and immediately following construction.

d. Compliance with applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act. The activities should not violate any toxic effluent standards.

e. Compliance with Endangered Species Act of 1973. The fill activities comply with the Endangered Species Act.

f. Compliance with specified protection measures for marine sanctuaries designed by the Marine Protection, Research, and Sanctuaries Act of 1972. Not applicable.

g. Evaluation of extent of degradation of the waters of the United States.

(1) Significant adverse effects on human health and welfare.

(a) Municipal and private water supplies. The fill activities would not affect water supplies except possibly during construction if the river is diverted, individuals that obtain river water for watering lawns may experience some insignificant declines.

(b) Recreation and commercial fisheries. During construction, the fill would have a minor adverse effect on the recreational fishery as a result of construction activities and temporary increases in turbidity.

(c) Plankton. The impacts on plankton would be minor, resulting mostly from burying and increased turbidity during construction.

(d) Fish. The impacts on fish would be minor, resulting mostly from disturbance caused by construction activities.

(e) Shellfish. The impacts on shellfish would be minor, resulting from destruction and burying by construction activities and a temporary increase in turbidity.

(f) Wildlife. The impacts on terrestrial or aquatic wildlife would be minor, resulting mostly from the direct effects of construction activities.

(g) Special aquatic sites. Not applicable.

(2) Significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems. No significant adverse or beneficial impacts would occur.

(3) Significant adverse effects on aquatic ecosystem diversity, productivity, and stability. No significant adverse or beneficial impacts would occur.

(4) Significant adverse effects on recreational, aesthetic, and economic values. The fill activities would result in minor adverse impacts to recreation and aesthetics because the cross-channel structures would be unnatural in the area and would necessitate a canoe portage.

h. Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. The use of clean fill, fill with substantially the same composition as the existing substrate in the area, and mechanical methods of placement and removal would reduce impacts on aquatic and terrestrial ecosystems. The only feasible alternatives to open-water disposal are in the no-action and the nonstructural measures, and neither of these measures would solve the existing flood control problem to an acceptable degree. The fill activities are required to accomplish the goals of the project. There are no practical methods to further reduce the impacts.

i. On the basis of the guidelines, the proposed disposal sites for the discharge of dredged or fill material are: Specified as complying with the requirements of these guidelines.

LME

-8